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NEW YORK, SATURDAY, NOVEMBER 2, 1912.

CONTENTS.

Editorials 907
November Meeting A. I. E. E..... 910
Arlington Wireless Station Tested..... 910
Electric-Vehicle Progress..... 910
Hydroelectric Projects on the Rio Alameda, Mexico..... 910
Steinmetz on the Future of the Electrical Industry..... 911
Convention of Illinois Electric Association..... 913
Decision in Malden Street-Lighting Case..... 916
Decision of Massachusetts Commission in Natick Rate Case..... 917
Public Service Commission News..... 917
Current News and Notes..... 919
Electric Service in Coal Regions..... 921
Practical Installation of Relays on Alternating-Current Circuits. By C. E. Freeman..... 924
The Use of Depreciation Data in Rate-Making and Appraisal Problems. By Halbert P. Gillette..... 927
Distribution of Conserved Resources Through Existing Public Utility Enterprises 931
Storage-Battery Regulation of Low-Head Water-Power Plant..... 932
The Four-Terminal Conductor and the Thomson Bridge..... 933
Relation of the Horse-Power to the Kilowatt..... 934
Storage of Coal and Spontaneous Combustion..... 934
Application of Electricity in Agriculture..... 935
Electric Cooking in the United States Navy..... 936
A Unit Schedule for Solicitors' Salaries..... 940
Preserving Poles with Water-Gas Tar..... 941
Bonus Award for Coal-per-Kilowatt-Hour Record..... 942
Illuminating Engineering for the Central-Station Salesman..... 943
Pole-Height Estimator..... 944
Rural Transmission Line with Iron-Cable Conductors..... 945
Some Reflections on Interior-Wiring Construction..... 945
Street Lighting in Alameda, Cal..... 946
A Kansas Concrete-Pole Transmission Line..... 948
Increasing Power Requirements of Moving Picture Arcs..... 948

LETTER TO THE EDITORS.

Wood Preservation. By William C. Thayer..... 948
Digest of Current Electrical Literature..... 949
Book Reviews..... 952
New Apparatus and Appliances..... 953
Industrial and Financial News..... 960
Directory of Electrical Societies and Associations..... 971
Weekly Record of Electrical Patents..... 972

ENERGY DISTRIBUTION IN THE COAL FIELD.

The description of the plant of the Luzerne County Gas & Electric Company in this issue is particularly instructive from the standpoint of economics. It presents the very unusual condition of an electrical system, covering some 30 square miles of territory right in the heart of a coal-mining region, selling a great deal of electrical energy to the mines and buying coal locally at current prices. In other words, it is in effect hauling coal from the mines and delivering back electric energy to the mines cheaper than it can be generated at the mine mouth. A somewhat singular set of circumstances led to the unusual results noted in the article. To begin with, the coal costs from $1.10 to $1.30 per ton, delivered—a price which forms a very forceful comment on the distribution of costs as shown in the fuel doled out by the coal roads to the Atlantic seaboard. Of course, the refuse and screenings available at the mouth of the mine would be cheaper than the buckwheat used, yet it appears that, on investigating the relative economies, the saving by using the cheaper coal is found to be not so great at might be anticipated. In some instances this result has been due to the scarcity of water supply at the mouth of the ordinary mine, and it is probably still more frequently chargeable to the difficulty of utilizing very cheap fuel on a relatively small scale. The economical burning of culm and similar fuel requires conveying apparatus on a pretty large scale and can be best carried out in a plant much larger than the ordinary mine would require. Hence it is that the plant described can afford to utilize cheap coal hauled from nearby mines and then distribute electrical energy back to the mines at a profit to both parties. The coal is actually hauled to the station in carts and dumped into a large concrete coal bin, from which a motor-driven conveyor distributes it to the boiler room. It is not even burned on automatic stokers, nor are the ashes disposed of automatically, although an ash-conveying system is about to be installed. The operating conditions make the success of the plant in energy distribution all the more remarkable. It is at least an open question whether, even with this cheap fuel, the energy costs are not needlessly high, considering the size of the plant, by reason of its design, yet the cost of fuel per ton is so low that any difference secured by a considerably more expensive plant would be so moderate as to make the economy a questionable one until the plant had to carry a much greater load. The requirements found necessary with coal selling at $3 or $4 may prove to be uneconomical with coal at $1.25.

The generating equipment of the system shows the progress of evolution. The first equipment consisted of three 500-hp, 60-cycle, two-phase units directly connected to Corliss engines. Up to two years ago the units were operated non-condensing. Then an 1800-kva low-pressure

turbine receiving the exhaust from the engine was installed, and this year a 3000-kva high-pressure turbine was added to the equipment, with still another of equal size in immediate prospect. The station is one of the comparatively few large two-phase plants still in operation. The transmission system presents no extraordinary features. It covers a distance of 26 miles north and south in the Wyoming valley, with various branches. The transmission voltage is 6600, and substations are located where necessary, the largest of them being of 1000-kw rating. This station at Kingston, Pa., is equipped with a 400-kw synchronous motor used as a condenser for the correction of the power-factor, a precaution rendered needful by the large induction motor load carried in connection with the mining work. Motor service is charged for on a maximum-demand basis, which makes its cost low for the large and steady users. There is, also, a considerable lighting load and a growing business in various heating devices.

The system represents an excellent example of the possibilities of energy distribution with cheap fuel in a territory supplied with fuel at a cost which a few years ago would have seemed to render electric motor service an economic impossibility. The fact is that people are beginning to learn something about the cost of energy generation on a small scale and have come to realize the important part played by incidental expenses under such circumstances. As this lesson is thoroughly taken to heart the advantage of motor drive become more and more apparent, and to-day motor service is really being extended all over the country in cases in which at first glance it seems uneconomical.

SOME PECULIARITIES OF WATER-POWER.

In spite of the very great importance of water-power and the thoroughness with which it has been studied on certain streams, few engineers have any adequate grasp of some of its idiosyncrasies or of the importance of these in organizing a hydroelectric system. Of course, the variations of rainfall at a given point are somewhat familiar. One knows, for example, that the wettest year of a long series may have twice as much rainfall as the driest year, and that no law of averages can be trusted unless established over a very considerable period. Attempts to find periodicity in rainfall have, on the whole, failed, although much study has been spent on this problem. So far as the general indications go, the amount of water available for hydraulic purposes through the year seems, then, to be an indeterminate variable. Two extremely low years may lie a quarter of a century apart in the records, or two such years may succeed each other immediately. And what is true of the rainfall of the year is in large measure true of its distribution through the months. Ordinarily, for instance, August is the extreme low-water month on streams in the eastern United States, but the autumnal minimum may be delayed until September or even October. The June flow, customarily assumed as a rough average flow, may on the same stream and in years of equal total flow vary by 100 per cent.

The thing which deserves more investigation than has usually been accorded it is the variation of rainfall and run-off in different parts of the same watershed or on adjacent watersheds. The time has come when water is growing increasingly valuable, and the problem before the hydraulic engineer is to secure for use the largest possible proportion of the rainfall in the territory in which he is working. To do this it is necessary to investigate thoroughly the probable variations not only of the whole but of the component parts, with a view to conserving all the water possible. It is often found, for example, that the actual average rainfall over a considerable term of years varies not a little at points on the same watershed or even on the same stream not many miles apart. To get the most out of the stream, storage space should, if possible, be arranged so as to take advantage of the points of maximum rainfall and presumably maximum run-off. If a point of excess rainfall can be isolated and the water stored, that water can be made to contribute to the steadiness of the general flow, and in utilizing a given watershed, as is often done for a group of allied transmission plants, great advantage can be taken of local variation. In some instances this is already done with admirable effect, although as a rule insufficient care is exercised in investigating the question. Study may show that it is advisable to utilize the flow which accumulates in a given stream not at the obvious point in a single plant but at two or three points so chosen that the waste flow may be a minimum.

In some of the large transmission networks which have been developed the steadying effect of distributed generating stations is very clearly shown, even though the stations themselves have not been planned directly with reference to conjoined operation. Only a beginning, however, has been made in work along this line, and it is quite possible to carry it so far as to reduce the waste water, except in brief periods of extraordinary flood, to a very modest amount. To gain the fullest advantage provision must be made for feeding energy to the network mainly from one or another of its generating stations according to the hydraulic situation. What is true of plants operating on a single watershed is doubly true of plants operated on separate watersheds, in which the flow may differ very widely. In either case it may readily happen that two streams of very different hydraulic quality can be united to their great and mutual advantage, as, for example, when one stream is fed largely by springs and diffuse drainage and another by melting snow. Every plant in the system should be kept thoroughly in touch with the other plants, and all should be operated as a whole, shifting the load wherever it will save water. If a large amount of otherwise waste water can be saved for a month or two each year by a combination of storage and excess equipment at that point, the economic gain may be considerable, and so far as the whole network is concerned it makes little difference how the spare machines, always needed to a certain extent, are distributed, provided there is behind them a reasonable amount of storage to help out during brief emergencies. The whole story is that while a number of splendid networks for the transmission of electrical energy have been developed they have mostly grown up as the result of individual efforts. To be of the most use when united, they should be reorganized after a study of the hydraulic situation as a whole, and the bigger the system the greater are the opportunities for efficient utilization of the whole run-off.

DEPRECIATION.

In view of the rapidly increasing interest in questions that belong in the realms of both engineering and economics, typified by many of the problems which arise in the regulation of public-service companies, it is not surprising to find renewed discussion of topics that have long received consideration among comparatively limited circles of engineers, accountants and economists. Such subjects as going-concern value and depreciation are foremost among these, particularly in respect to appraisals of public-utility plants. Elsewhere in this issue there is an article by Mr. Halbert P. Gillette on the use of depreciation data in rate-making and appraisal work which is well worth the careful study of all engineers and managers who deal with public-utility problems. It is universally admitted that plants depreciate or shrink in value through the ravages of physical and economic forces and that no part of any plant can escape the ultimate day of its abandonment and renewals. If useful life of a plant unit is known with tolerable accuracy, it becomes a simple matter to distribute the cost of renewal over the years of service in order to make a uniform annual charge against the earnings. But when it becomes necessary to subtract accrued depreciation from cost new, in the process of arriving at present value, as in appraisals, a deep significance attaches itself to the particular theory of depreciation held by the appraisers. Thus two different appraisers, holding unlike views as to the rate at which dereciation creeps forward from year to year within a given span of life, may arrive at considerably divergent estimates of the present value of the same plant.

Two different theories as to the rate at which property depreciates from year to year within a given lifetime have been widely held, the straight-line theory and the sinking-fund-curve theory. Both of these methods have been defended by eminent authorities. Now comes a proposal for still another method, based on a new statement of economic principle involved, for which Mr. Gillette stands sponsor. In examining it one is impressed by the fact that the cost of producing the plant output or product enters fundamentally into the conception of the proposed method or theory. As a calculation to determine the most that a second-hand machine would be worth to a given purchaser, the method seems flawless, but to say that such a calculation fixes in every case the present or depreciated value of a plant or machine is a proposition which is hardly proved by the presentment of the case. Clearly the method requires modification when it results in a negative present value, or a value less than the scrap or salvage value, as it may do. Notwithstanding these defects, and others which arise from disregarding financial, legal and physical factors in depreciation, the method is decidedly interesting.

The author's remarks in reference to the prevalent confusion of maintenance and depreciation in the accounting practice of public-service corporations are much to the point. The tendency now is to confine depreciation, in a bookkeeping sense, to replacements of a major character, such as an entire machine or generating unit, but it seems evident that a more careful study of this phase of the problem would be decidedly profitable.

UTILIZATION OF CONSERVED RESOURCES.

Much has been said and written on the conservation of natural resources, and of late great stress has been laid upon the statement that water is the chief resource to be conserved. Indeed, the national government has spent millions during the past few years on a systematic investigation for determining the water supply of the country. This work has involved the gaging of streams, the investigation of underground currents and artesian wells and the preparation of reports on the best methods of utilizing the water resources. In addition, several of the states have expended large sums for similar investigations on their watercourses. The importance of data on water-powers is generally recognized, and it is well that the most accurate information in regard to water supply and water-powers be made available by the government. To be sure, the general statements so commonly made of the vastness of the water-powers are misleading and disguise the fact that many of the sites are worthless judged from present economic standards of development. But if the government be the owner of the water-powers it is important that it possess all the facts bearing on them. Politicians and conservation enthusiasts may have hysteria over distorted facts; but it is fortunate that few of the citizens of the country are of violent, emotional blend, so that dependence can be placed on the optimism and sober sense of the country as a whole. The average man sees nothing in a power site. To him it is a plunging stream, pleasant to look upon but dangerous to life and therefore to be avoided. It is a matter of indifference to him what disposition is made of the site, and if efficient use is made of it and its powers are developed for the benefit of the community, he believes that conservation in its broadest and best sense has been attained, and water-power thus utilized for the community is certainly in a sense conserved.

Amid all the bickering and strife occasioned by the question of conservation few have stopped to consider how best to utilize the forces thus conserved. To this phase of the subject attention was recently given in an address before the New York State Waterways Association, an abstract of which appears elsewhere in this issue. Bias can doubtless be charged against the speaker, schooled as he has been in the central-station art; but who can gainsay the logic of his argument that the results of conservation can be more advantageously placed at the disposal of the people through the highly developed public utilities than through any other agency? The possibilities of a water-power placed in such hands are well emphasized, and the scheme as it unravels reads not unlike the parable of the talents, for the speaker shows wherein 5000 hp committed to the charge of a central station can be made to serve a maximum demand of 22,500 hp and even more if the diversity factor of the system is large enough. No other enterprise is better situated to utilize natural resources in such a way that they will be truly conserved, and none can more readily place them at the disposal of the rightful beneficiaries. Certainly the scheme proposed is a happy solution of a vexed question and it should be driven home with force. If the people at large are to reap the benefits of conservation, the modern well organized and developed public-utility companies should be the channel through which these benefits flow.

NOVEMBER MEETING A. I. E. E.

A meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York, Nov. 8, under the auspices of the industrial power committee. The general subject of the evening will be "The Electrification of Steel Mills." Two papers will be presented as follows: "Power Requirements of Rolling Mills," by Mr. Wilfred Sykes, and "The Economical Speed Control of Induction Motors for Rolling Mills," by Messrs. F. W. Meyer and Wilfred Sykes, of the Westinghouse Electric & Manufacturing Company. At the close of the technical session the meeting will adjourn to the Institute offices on the tenth floor, where the usual smoker will be held.

ARLINGTON WIRELESS STATION TESTED.

The wireless station erected by the United States Navy Department at Fort Meyer, Arlington, Va., which when completed will represent an investment of over $1,000,000, was tested on the night of Oct. 28, when messages were sent to the Key West and Colon stations. It is expected that the station will establish a sending radius of 3000 miles under ordinary weather conditions. Its most striking feature is the three steel towers, connected at their tops by a series of twenty-three wires, from which the messages will be radiated and received. The towers are arranged 400 ft. apart at the corners of a triangle foundation around a central receiving and sending station. The westernmost of these towers is 600 ft. high and 150 ft. square at the base, while the two other towers are 450 ft. high and 120 ft. square at the base. The wireless equipment in the station, although built especially for the navy, is not entirely new, having been in use at the Fessenden station at Brant Rock, Mass., in 1910, where it was subjected to exhaustive tests for a period of over eight months. The equipment comprises a 100-kw motor-generator set, energy for driving which is purchased from the Potomac Electric Power Company, of Washington. At the end of the motor-generator shaft is a synchronous rotating spark-gap. The principle of the Fessenden system as built for the navy, as well as a diagram of the connections, was published in the *Electrical World* March 31, 1910.

ELECTRIC-VEHICLE PROGRESS.

At the luncheon of the Chicago Section of the Electric Vehicle Association held on Oct. 22 reports were received from the recent Boston convention of the parent association. Mr. Putt, of the General Electric Company, spoke of the interest shown in the standardizing of charging plugs and garage signs. Mr. George H. Jones, of the Commonwealth Edison Company, who presided, pointed out the advantages of individual rates for charging electric vehicles in garages. By this means the garage man charges the vehicle owner for the actual amount of energy used on a measured basis. This is an advantage to the garage owner in taking on electric trucks, as he is often doubtful in making a flat rate for vehicles of this class. Mr. C. B. Frayer, of the Edison Storage Battery Company, abstracted some of the papers presented at the recent convention. Mr. Julian G. Kirsten, of Kansas City, representing the Anderson Electric Car Company, spoke of the advantages of electric automobiles in the warm climate of the Southern States. There is a great field in this part of the country, particularly in Texas, which is now in a very prosperous position. The garage proposition is the most serious, for cars need proper attention after they are sold. The speaker advocated a policy of educating garage owners as well as individual owners in caring for electric cars. The field is so large that there is room for all. One thing that is wanted is more trained men in the selling of the electric vehicle.

Mr. Edwin E. Witherbee, of the General Vehicle Company, brought up the question of the speed of the electric truck and said that manufacturers should adhere to a definite standard. Mr. Ernest Lunn, of the Walker Vehicle Company, agreed that a standard of speed was desirable, although exceptions might be made in unusual cases. Mr. E. L. Callahan, of H. M. Byllesby & Company, spoke of the need for co-operation by central-station companies. Mr. H. Farrington, editor of *The Power Wagon*, advocated co-operation between the makers of electric and gas trucks, stating that gas-truck competition must not be underrated.

VEHICLE-CHARGING STATION IN MASSACHUSETTS.

The Electric Vehicle Club of Boston has issued a booklet dated Nov. 1 giving the names and addresses of the principal electric charging stations in Massachusetts, some seventy municipalities being covered by the list, which includes 105 charging points, 76 establishments where batteries may be charged at all hours of the day and night and 15 places giving emergency charging service only. The available service ranges from Pittsfield and North Adams on the west to Provincetown and Oak Bluffs on the east and south. Twelve main charging points are located in Boston proper, and the suburban district of Greater Boston includes about twenty-five other stations for this purpose. Mr. H. F. Thomson, Massachusetts Institute of Technology, Boston, is secretary of the club.

HYDROELECTRIC PROJECTS ON THE RIO ALAMEDA, MEXICO.

The water-power rights of the Alameda River located within the State of Morelo, Mexico, were recently acquired by the Cia Hidro-Electrica del Rio de la Alameda, S. A., which company is owned largely by French investors. For the purpose of utilizing the energy at these falls it has been decided to build three central stations with an aggregate generating rating of 25,000 hp. The construction work has commenced on one station, which will have an initial instalment of two 4000-hp Escher Wyss turbines and later a third turbine of the same rating for reserve. The station will be located 2 miles from the intake and will be connected by a double pipe line furnished by the Aktien Gesellschaft Ferrum. The generators will be wound for 6000 volts, 50 cycles, and will have directly connected exciters. One reserve exciter and a 150-hp turbine will also be installed.

From the power plant the energy will be transmitted by a 44-mile double transmission line to La Piedad substation, near the city of Mexico, whence it will be carried underground into the city. At the power station the emf will be stepped up to 60,000 volts by means of groups of single-phase, oil-insulated, water-cooled transformers, and at the substation the same kind of transformers will be provided for stepping down the voltage to 3300. For the transmission line use will probably be made of steel towers and suspension insulators built by the Porzellan-Fabrik Hermsdorf. There will be three switching stations on the line, each equipped with the proper lightning protective apparatus. A double telephone line will also be provided.

At switching station No. 3 a branch line is taken off to Tizapan substation, a distance of 4 miles. At this substation will be installed a reserve equipment consisting of two 1500-hp Diesel-engine generating units, which will later be increased to five units. These Diesel engines, which are to be made by the Maschinen-fabrik Augsburg-Nürnberg, are said to be the largest of their kind on the American continent. The project involves the installation

later at Tizapan of four 2250-kva transformers, from which to supply energy for the surrounding manufacturing district for motor service. The Siemens-Schuckertwerke, Mexico, are making all the electrical installations now in progress. Two other power stations are to be built later and will be operated in parallel with the one now under construction.

RECENT PATENT DECISIONS.

In the United States Circuit Court of Appeals the Rowntree patent, No. 666,699, for a signal system for electric elevators, was held valid and infringed, in the action known as Standard Plunger Elevator Company versus Burdett-Rowntree. In the case of the Electric Storage Battery Company versus the Gould Storage Battery Company the United States District Court held the Madden patent, No. 570,224, for a machine for making grids for secondary batteries, not infringed by the machine of patent No. 572,363, issued to the same inventor.

The United States District Court, in the case of the Bryant Electric Company versus David Killoch Company, held the Seeley reissue patent, No. 12,757, for an incandescent lamp socket valid and infringed.

STEINMETZ ON THE FUTURE OF THE ELECTRICAL INDUSTRY.

Taking as his subject "Some Problems in Electrical Engineering," Dr. C. P. Steinmetz devoted his annual lecture in Chicago on Oct. 28 to an estimate of the future development of the electrical industry. The address was delivered, as in former years, at a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers and does not differ in substance from the address made by the same speaker at the recent convention of the Association of Edison Illuminating Companies at Hot Springs, Va. Mr. W. C. Armstrong, president of the Western Society of Engineers, presided. The speaker remarked in beginning that an endeavor to forecast the future development of the industry must, of course, be a matter more of guesswork than of exact determination. Nevertheless, there are some marked tendencies to be observed. These result from the development of industrial laws, and by following them out an estimate of future development may be made with a moderate degree of confidence.

CONCENTRATION OF SUPPLY.

There is a marked tendency in generation toward the concentration of the supply of electrical energy for all uses for a large territory from one system. The large system has economical advantages over numerous small ones. One of its most conspicuous advantages is the possibility of utilization of the diversity-factor. The price of producing electrical energy depends to a large extent on the load-factor. The station must be such as required by maximum demand, but the income depends on the average demand. The load-factors of most users of electrical energy are relatively poor. Even the factory operating continuously for eight hours creates a demand during only one-third of a twenty-four-hour day. However, if a number of users of electrical energy are supplied from the same generating system a better average will result, owing to the diversity-factor of the different loads. Therefore, the more different uses there are for the energy the less will be the cost.

THE DIVERSITY-FACTOR OF INTELLIGENCE.

Beyond the advantage of this diversity-factor, which is now obvious, there is another diversity-factor, which is of perhaps even greater advantage, though not so apparent to casual inspection. That is the diversity-factor of intelligence. New problems arise with the development of the large system. A central-station system in a city of moderate size may have one or two first-class engineers, but in the large systems, where new electrical problems arise, and also mechanical problems and problems of administration and finance, no man can be an expert in all the varied activities of the company. And so there will be found attached to the system the highest authorities in the various branches required for the most efficient operation of the system. The men in charge of such a concentrated system of production should not be merely up to date, but should be, in fact, ahead of date. That is, they should solve in advance the problems which will arise. Here is an advantage of the greater system probably much more important than that of better load-factor. It may be called the diversity-factor of intelligence.

PRIVATE PLANT VERSUS CENTRAL STATION.

When electrical energy was first applied to the operation of machinery it was generated at the mill or factory where it was used. However, the factory is specialized for its purposes as a factory. Its management is efficient in cotton spinning, say, but not in the operation of an electric plant, and unless the circumstances are exceptional cannot be so efficient in the specialized detail of producing energy for use in its own work. That accounts for the fact that it is usually found more economical for the cotton mill to purchase electrical energy from institutions which are specialized for the purpose of producing it. In general, it is not economical to attempt to carry on simultaneously the manufacture of cast-iron pulleys, say, and the production of electrical energy by the same organization.

THE ELECTRICAL NETWORK OF THE FUTURE.

As the generation of electrical energy is being concentrated in larger system units at the present time, what will be the future of the industry? Evidently the territories served will increase in size. Some may be counties, some parts of states and some small states, and so on. Big cities have an advantage in this respect, of course, because they have as a nucleus their own large demand. The outcome must be the replacement of village and small-city generating plants by the substations of big systems. Old machinery will thus be replaced by modern types. These big generating systems will tend to approach one another; then will come, no doubt, an era of co-operation, and it is not too much to expect a network of energy-transmission wires covering the country, just as the railroads do to-day. Energy will be transmitted in the one case as freight is transported in the other. The right of condemnation which is given to railroads should be given to the owners of the great transmission lines also, and a recalcitrant village or small city should not stand in the way of a great sectional or even national development. But before this privilege of condemning right-of-way is given to the great power-transmission companies there may be on the statute books some laws in relation to co-operation and the regulation of utilities corresponding with the spirit of the twentieth century, instead of the present statutory mixture inherited, in some respects, from the time of Alfred the Great. Responsibility must go with authority in the case of the transmission systems. The latter should have power given to them, but should not be allowed to abuse this power.

PHYSICAL CHARACTERISTICS OF THE FUTURE SYSTEM.

It may be possible, said Dr. Steinmetz, to go a little further and estimate how such a development will take place. The local distribution system will remain the same probably as now; that is, a three-wire system for either direct current or alternating current. This system of distribution has stood the test of over a quarter of a century and will probably remain. The distributing substations will probably be supplied over 2200-volt alternating-current feeders, the energy being transformed to 600-volt direct current for railway operation or 220-volt direct current or

alternating current for various forms of commercial service. Beyond this will probably be an intermediate system of feeders around 10,000 volts which may be styled transmission feeders. These, like the 2200-volt distribution, will be laid underground in cities and carried as overhead lines in the country. For greater distances 20,000-volt or 30,000-volt distribution lines will be supplied, and these, too, will be underground in city districts. In this class of transmission in overhead work in the country it is probable that the highest voltage will be adopted which does not require special precautions in installation, say, about 30,000 volts. But there will be flexibility in these transmission feeders, and some will operate at as high as 60,000 volts. In addition to these there must be great trunk lines for the transmission of electrical energy radiating from the big generating centers and comparable to the trunk lines of railways. These will be built for the highest practicable operating emf—probably between 150,000 volts and 200,000 volts—or, in othtr words, at the limit imposed by the dissipation of energy into the atmosphere through the corona effect.

EFFICIENCY OF A NATION-WIDE SYSTEM.

Considering this whole great system of generation, transmission and distribution, it may be interesting to speculate on its efficiency as a whole. There will be at least two transformations of energy and, figuring on these and the line losses, it is probable that the average loss between the generator terminals and the customers' meters, possibly 100 miles away, will be less than 10 per cent. The exceptionally high-voltage transmission lines spoken of will probably not carry large amounts of energy. They will rather be tie lines between two great city systems, and in general only a moderate degree of energy will flow through them. They will be for emergency connections between two great systems and for use in helping out in cases of peak-load, contributing to the reliability of operation and serving as a sort of insurance.

INDUSTRIES FITTED TO POWER RATHER THAN POWER TO INDUSTRIES.

At present the industries demand energy usually for eight hours a day. If industries could be developed to utilize energy in the other sixteen hours the problem would be solved, and that, in fact, is the great problem of the electrical engineers of the future. Old industries cannot of themselves be expected to change a great deal, although something can be done. It may appear rather far-fetched to expect industries to adapt their conditions to entirely different hours to avail themselves of cheap energy. Still, some large industries have adapted themselves to such an arrangement. The steam engine, for instance, has encouraged a uniform load in factory production. If one looks around without prejudice he will be astonished to find how many industries are affected vitally by the characteristics of the motor service available. Our methods are really the result of the characteristics of the tools we use.

The steam locomotive, for example, has impressed itself to so great a degree on railroading that it is hard to consider it only as an incident. The coach horse dominated transportation in the earlier days; the electric motor has still different characteristics, but the steam locomotive has so dominated the railroads that it is difficult for railroad men to think of transportation in units best adapted to utilizing the advantages of the electric motor.

It is difficult to understand that new forms of motor service need not be adapted to old industrial methods. but rather that the industrial methods should be rearranged to use the service to best advantage. An industry utilizing electricity from a big national interconnected system must be adapted to the new conditions to get maximum economy.

PART PLAYED BY WATER-POWER DEVELOPMENT.

At the close of his remarks Dr. Steinmetz spoke briefly about the utilization of water-powers and their relation to the unified system of generation, transmission and distribution which he had assumed. Water-power is cheap but not very reliable, he said. Some uses of energy require absolute reliability, as in the central-station service of a big city. Here the use of water-power is out of the question, ordinarily, without a continuous steam reserve. But in some cases the interruptions to service are not so serious. The speaker analyzed momentary and anticipated interruptions to service, with their effect on various industries. As an illustration he took the case of an electrochemical or electrometallurgical industry taking 100,000 kw. Here, where the use of power is very large and the number of men employed comparatively small, it might be profitable to shut down the entire plant, even with a large investment, for two months in the summer, giving workmen a vacation with full pay, by reason of the economies effected in even a very slight reduction in the cost of each unit of electrical energy purchased. In this case the use of water-power, even with a long interruption (where the interruption might be anticipated and provided for), is decidedly advantageous.

The whole problem of utilizing water-power requires very careful consideration, and that is true of all the relations of the production of energy and its utilization by industries. The specialist of the electrical industry is a great intermediary in this matter of energy production and utilization. He must go into the other industries and reorganize them to adapt themselves to the motive-power characteristics of the future day. The great problem is to reorganize the industries to use advantageously the energy made available by electricity. That problem, said Dr. Steinmetz in closing, is still before us.

Discussion.

In answer to a question as to how the central station could compete with the factory owner in providing motive service for the latter, inasmuch as the electric-service company has to allow for a profit, Dr. Steinmetz said that the private-plant owner must make a profit on his investment in plant also, and the small plant cannot avail itself of the economies that the large system can realize.

Referring to the question of generating electricity at the pit's mouth by burning the coal there rather than by transporting it by rail to the point of consumption, the electricity to be transported instead, Dr. Steinmetz said that since so many factors enter into the question, each proposition of this kind must be studied out by itself. Generally, where freight is high and the grade of coal poor it ought to pay to use the coal to make electricity at the coal mine, the energy then being transmitted electrically. However, where the coal is of high grade and, say, water transportation is available, it will undoubtedly be found cheaper to ship the actual coal. At the present time it would probably be economical to convert inferior fuel, say the culm pile at coal mines, into electricity. If this was done to take care of fuel now thrown out altogether it would be possible later on to figure out the economies in utilizing the entire output of the mine. However, as in water-power transmission, the factor of reliability of service over long transmission lines must be taken into account.

LECTURE ON TUNGSTEN.

At a meeting of the New York Electrical Society held on Oct. 29 at the College of the City of New York Dr. Charles Baskerville gave an interesting lecture on "Tungsten." The history of the metal was recounted from the time of its discovery by Scheele in 1781, when it was called tungstein. The most important historical dates and the scientists connected with them are given herewith.

Tungsten occurs in nature as tungstates. The principal one is the iron salt, known as wolframite, represented by the formula $FeWO_4$. Calcium tungstate, $CaWo_4$, or scheelite, and lead tungstate, $PbWO_4$, or stolzite, are also found

in nature but in smaller quantity than wolframite. Tungsten may be prepared from wolfram by heating the powdered ore with sodium carbonate, extracting the sodium carbonate with water, filtering and adding an acid to precipitate tungsten acid, H_2WO_4. This is washed and dried and the oxide thus obtained is then reduced to the metal by heating with carbon to a high temperature. Tungsten is also obtained by heating the oxide with carbon in an electric furnace, in which case the product is porous and can be welded like iron.

Reference was made to the various uses of tungsten and its alloys. Particular attention was given to the tungsten

DATES IN THE HISTORY OF TUNGSTEN.

1781.	Tungstein discovered	Scheele
1783.	Wolfram containing tungsten	De Elhuyer
1815.	Alloy with iron	Hassenfratz
1826.	Atomic weight	Berzelius
1836.	Yellow to blue oxide	Malaguti
1868.	Five per cent tungsten steel rails.	
1882.	Tungsten shot	Mieg and Bishoff
1887.	First filament	Bottome
1903.	Filament	Just and Hanaman
1905.	Filament	Kuzel
1905.	Filament	Auer von Welsbach
1907.	Filament	Siemens & Halske
1908.	Filament	Westinghouse
1910.	Filament	General Electric Company

filament as being the application of most interest to the electrical engineers. The speaker told of the difficulties encountered in removing from the metal impurities such as sulphur, arsenic, antimony and phosphor, which was very essential in order to obtain a sufficiently strong and uniform filament. Besides this, the carbon which is used in producing the tungsten must be removed, which caused considerable difficulty. The honor of the development of tungsten, the speaker said, has wrongly been claimed by and given to Austria, when, in fact, it belongs to America. Credit should be given particularly to Dr. W. R. Whitney, of the General Electric Company, for bringing the tungsten filament to its present state.

CONVENTION OF ILLINOIS ELECTRIC ASSOCIATION.

More than 200 members attended the convention of the Illinois State Electric Association at Peoria, Oct. 22 to 24, which, in point of program and numbers, was generally declared one of the best meetings ever held by the organization.

With President H. A. Foster, of Fairbury, in the chair, Tuesday's session was opened with a paper on central-station accounting, by Mr. A. S. Scott, Chicago. Pointing out the desirability of uniform methods even in small stations, the author presented the schedules for classifying expenses, investment and income in plants of various sizes recommended by the National Electric Light Association. Messrs. H. E. Chubbuck, Ottawa; John Maury, Rossville, and F. M. Sinsabaugh, Mount Vernon, spoke briefly.

ELECTRIC ICE MAKING.

In his paper, "Ice Making with Electric Power," Mr. J. R. Cravath, consulting engineer, Chicago, discussed motor-driven compressor plants using distilled, raw and re-evaporated water. The increasing number of transmission systems and the consequent discontinuance of many local steam-power plants with ice auxiliaries makes this subject one of present great importance. Raw-water ice plants are in operation at Chicago, Joplin, Mo., and Columbus, Ohio. From 40 kw-hr. to 60 kw-hr. is required to make a ton of ice. The air compressors for agitating raw-water plants demand about ¼ hp per ton of daily capacity. From 1 gal. to 4 gal. of cooling water, at 50 deg. to 85 deg. Fahr., is the usual requirement for each ton daily output.

Mr. J. G. Learned, Chicago, reported that the Commonwealth Edison Company now has 2000 kw connected in ice-making load. Local ice manufacturers, he said, declare they can make ice electrically at a lower cost per ton than the freight charges on natural ice brought from the Wisconsin lakes. One Chicago ice factory has an electrical load factor of 85 to 90 per cent and turns out its product at 48 to 52 cents per ton, in competition with lake ice costing 55 to 60 cents per ton. Mr. Learned urged central stations to encourage raw-water ice making since it is usually impossible, he said, to sell electric service to distilled-water plants. Mr. J. J. Frey, Hillsboro, declared that he knew of no system of raw-water ice making which can be operated profitably. His manufacturing cost, he said, is 80 cents per ton. Mr. E. H. Negley, Canton, suggested the advantages of central stations selling their distilled water condensate to ice plants in addition to energy for motor service. Mr. E. W. Smith, Kewanee, referred to the high maintenance costs on re-evaporating and distilling apparatus. Mr. C. W. Pen Dell, Chicago, declared that ordinary drinking water should be good enough for ice making, an argument useful to refute customers who object to raw-water ice. With a little effort, he said, central stations should be able to get all future ice plants as customers on an off-peak schedule. Mr. Cravath insisted it would be out of the question to expect ice plants to shut down for even an hour or two during summer peak periods, but added that the summer peak usually falls so far below the winter load that no difficulty should be experienced in carrying the ice plant continuously. Messrs. L. E. Marshall, Dixon; H. E. Chubbuck, Ottawa; H. A. Foster, Fairbury, and A. S. Scott, Chicago, a'so took part in the discussion.

SERIES STREET LIGHTING.

Mr. H. G. Hoke, Westinghouse Electric & Manufacturing Company, Chicago, followed with a paper on "Series Tungsten Lamps for Street-Lighting Purposes." The author outlined appropriate installations for business and residence streets, parks and boulevards and described the operation of the adjuster-socket and regulator systems of series control. Mr. E. H. Negley spoke of lightning troubles on his street-lighting system at Canton, where the loss of many lamps has been suffered during each storm. Mr. C. F. Snyder, Bloomington, said that with lightning arresters placed on every long run of his 4-amp series system not a dozen lamps are lost a year, although many film cut-outs are punctured. Mr. W. J. Day, Bement, uses arresters each third of a mile and has had no lightning troubles. Mr. Hiatt, Chicago Heights, said that his former mixed series operation of arc and tungsten lamps gave trouble during storms or when the transformers were "pumping" badly, destroying so many tungsten lamps that he was forced to give up their use in this way. Mr. E. W. Smith, Kewanee, cited, on the other hand, his own eight years' successful experience with similar mixed series operation.

ELECTRIC VEHICLES.

"The Electric Vehicle as Central Stations Should View It" was the title of a paper by Mr. G. H. Jones, Commonwealth Edison Company, Chicago. He emphasized the value of electric truck and pleasure-car charging as an off-peak load, improving plant load-factor and reducing operating costs. Curves which he presented showed the practical value of the vehicle load on the Chicago system. In closing the author advised electric companies to use electric vehicles in their own business, to take an automobile agency and start a garage if there is no active vehicle representative in town, to establish reasonable rates for charging service, to appoint one man in the company as its vehicle specialist, and to advertise and co-operate with the publicity campaign of the Electric Vehicle Association of America. Mr. Jones exhibited slides showing sample advertisements used in this campaign.

Mr. F. W. Reimers, Rock Island, advocated the use of

electric vehicles exclusively by central stations. Mr. J. R. Cravath, Chicago, spoke of electric-roadster development. In reply to inquiries Mr. Jones gave 3-amp-hr. per mile at 25 miles per hour as a fair consumption for pleasure cars. Contrasting maintenance costs, he told of a visit to the shop of a New York department store which besides its electric cars has thirteen gasoline cars, seven of which were at the time undergoing repairs. Of the seventy-five electric vehicles in the same service, three were in the shop. In the large sizes electric and gasoline trucks average the same, weight for weight, he said, although the smaller electric trucks are slightly heavier than the gasoline cars. Mr. H. W. Young, Chicago, urged central stations which undertake vehicle service to provide an experienced troubleman. Nine-tenths of the troubles reported, he said, are found to be due to low acid in the cells or to some other simple cause. Mr. J. H. Delaney cited the testimony of a prominent manufacturer who has reduced his costs 40 per cent by replacing gasoline cars with electric cars. Messrs. Edgar Switzer, Chicago; E. H. Negley, Canton; J. J. Frey, Hillsboro, and T. W. Gregory, East St. Louis, also spoke in the discussion.

The new "primer" of the Illuminating Engineering Society, "Light, Its Use and Abuse," was next exhibited to the convention by Mr. J. R. Cravath, who explained the aims of the society in compiling it. The booklet is sold at cost.

WINDOW LIGHTING.

"Window Lighting," a paper by Mr. C. F. Snyder, Bloomington, outlined the principles of good display illumination using concealed lamps and reflectors. A window, 15 ft. by 12 ft. by 6 ft., he said, can be well lighted by six 100-watt tungsten lamps in reflectors. High window intensities attract passers-by and increase business. Ornamental street lighting, declared Mr. Snyder, acts to increase window intensities as soon as the merchant finds his displays appear dark by contrast. When inaugurating a window-lighting campaign, the author advised concentrating first attention on a progressive merchant, getting this initial installation complete, after which other local firms will follow easily, he said.

Mr. T. W. Gregory, East St. Louis, employs a flat rate of 0.8 cent per watt connected for window lamps burning from dusk to 11 p. m., the customer making his own renewals. Mr. L. E. Jackson, Dixon, recommended 1 cent per watt per month as easy to figure, the company furnishing renewals. He recommended using a 40-watt lamp for each 12 in. of window frontage. Mr. E. H. Negley, Canton, said many of his customers use fans in their windows all winter to free the glass of frost.

SUBURBAN AND RURAL DISTRIBUTION.

Mr. H. B. Gear's paper, "High-Tension Distribution in Northern Illinois," was read by Mr. O. O. Rider. The 33,000-volt, 60-cycle transmission, with 4600/8000-volt four-wire subsidiary lines, was described in detail. Generating stations are 25 to 50 miles apart, but the voltage has been chosen low enough to permit tapping lines for even 25-kw transformers for small-town substations. Outdoor 33,000-volt transformers can be used, saving building entries in sizes below 75 kw. Using the four-wire subsidiary lines, part of the substations can be eliminated by installing in an existing substation the regulators which are needed. For future agricultural demands this four-wire construction will also prove very adaptable.

Mr. E. L. Brown, Elmwood, described his interconnected system serving seventy-five farm customers. The demand of this class is unusually uniform, he said. The farmer needs service for various purposes all day long and is, especially, a pleased user of household labor-saving devices. Small motors drive his pumps, churns, cream separators, etc. Rural users are extremely appreciative. One farmer's wife remarked after a week's experience with her electrical conveniences that she "feared it was all too good to last." Mr. C. W. Pen Dell, Chicago, explained that the Public Service Company has limited single-phase motor sizes to 10 hp, although this value may be exceeded with the new unity-power-factor motors. Mr. T. Bass, Farmington, reported serving eleven farm customers over 3 miles of 2200-volt iron-wire line. Mr. E. H. Negley, Canton, reported transferring a telephone circuit onto the power-line poles at a uniform distance, to prevent noise. Vertical ground wires are run down each pole as lightning protection. Mr. H. W. Young, Chicago, spoke of the development of a self-contained 33,000-volt air-break switch, horn-gap lightning arrester and fuse for the Public Service lines. The switch can be tripped by hand, remote-control or overload release, butt-joint contacts preventing any possibility of freezing. Mr. L. Owen, Peoria, recommended ground wires down each pole, as affording the best protection. Mr. Bass described his use of kick-coils, consisting of twenty turns of wire around a 4-in. pipe, to protect transformers. The latter are never installed at the ends or corners of lines. By laying out several proposed lines through a rural district, competition is aroused, so that the farmers often offer inducements to get the right-of-way. For $1 nominal consideration legal permission can usually be obtained for setting poles inside the fence lines. President Foster, Fairbury, cited a case in which after ten years' free occupancy of such pole space the company was sued for rental, but by advice of complainant's counsel this suit was later dropped. Mr. Foster also quoted authority to show that an electric company can condemn rights-of-way for its lines. In building its farmers' extensions the Elmwood company, said Mr. Brown, charges the customer $1 per pole, requiring him to haul and set the poles and board the construction crew during the work. Permission for the line is obtained from the county supervisors, a quitclaim form being used.

ORNAMENTAL CURB LIGHTING.

Mr. W. F. Hansgen, Rock Island, Ill., opened the Thursday afternoon session with a paper on "Ornamental Post Lighting," describing tungsten "white-way" installations. Although the methods of payment for this service have to be determined by local conditions, the author recommended securing a city contract if possible. Mr. J. G. Learned, Chicago, in discussion, urged that cities develop their civic pride in lighting matters, without depending too largely upon individual merchants and advertisers. Too high sidewalk intensity requires higher window intensity or incurs disappointment. Window lighting, he said, is easier to get than "white-way" lighting, and should be attacked first. Post lighting, he added, too often promotes the demand for underground construction. Mr. T. W. Gregory described his magnetite lighting in East St. Louis, one lamp per 100 ft. for a distance of 2 miles, the cost being met by the city. Mr. H. W. Young described the new Chicago tungsten lighting, recently detailed in the *Electrical World*, converting gas posts to tungsten standards at a cost of $6.25 per post. The cable was laid bare in a trench alongside the curb, 2500 ft. being placed in two days. Mr. J. H. Delaney, Chicago, cited an instance where property near the stockyards, Chicago, rose 25 to 27 per cent in sale and rental value following an ornamental lighting installation. Messrs. H. A. Foster, Fairbury; E. L. Brown, Elmwood; C. A. Tatman, Monticello; L. E. Jackson, Dixon, and E. MacDonald, Lincoln, also spoke.

HOUSE-WIRING CAMPAIGNS.

"House Wiring" was the title of a paper by Mr. H. C. McMillan, Rockford, in which the writer advocated newspaper and personal advertising and personal solicitation as aids to a successful campaign for residence service. The value of the residence business is too often depreciated, he thought, by starting the new solicitor on this work with the knowledge that his promotion will be to the commercial sales department. Instead, special residence men should be

developed and maintained as a regular staff. In Rockford, by co-operation with contractors, a six-room house can be wired for $32, payable also in instalments of $5 down and $2.25 a month.

Mr. M. Hart, Chicago, referred to the delay that so often results on contractors' wiring jobs. Mr. J. G. Learned said that residences have a maximum demand of only 25 per cent of their connected load and merit more attention from the commercial department. Mr. R. S. Wallace, Peoria, urged the use of the terms "sales department" and "salesman," instead of "new-business department" and "solicitor." Mr. F. M. Sinsabaugh, Mount Vernon, also recommended "customer" instead of "consumer." Mr. Theodore Bass, Farmington, spoke of the advantages of direct and newspaper advertising. Mr. H. J. Pepper, Champaign, admitted that such advertising prepares the way for sales work but insisted that only personal solicitation by a salesman can secure the business. Mr. C. W. Pen Dell, Chicago, pointed out that salesmen are relatively expensive and that much of their time is wasted in fruitless calls. They can visit only a few customers, while a newspaper "ad" reaches all. The speaker advocated detailing one man to write all advertising copy. Mr. Johnson, Dixon, said that only a fraction of the readers see the average "ad." Mr. G. R. Jones, Chicago, spoke of the value of cultivating the newspapers' friendship. Mr. Hiatt, Chicago Heights, said that salesmen need more instruction and enthusiasm in their work. Mr. C. A. Tatman, Monticello, while admitting the value of advertising in larger places, insisted that newspaper publicity is wasted in communities of less than 2500. President Foster, Fairbury, referred to the difficulty of getting proper wiring construction done where no inspection is provided. One curbstone wireman was found using insulated iron wire for interior work. Mr. F. J. Baker, Chicago, said that on one occasion, when suspicious of a contractor's intentions, the company got the architect to place an inspector on the job, the company paying his salary. Mr. T. J. Wolf, Sterling, advised securing the passage of a town ordinance making the National Code the local standard. Mr. E. MacDonald, Lincoln, said that where wiring is improperly done payment can be held up.

ELECTRIC SIGNS.

"Electric Signs" was the subject of a paper by Mr. G. E. Fuller, Federal Sign System, Chicago. The author submitted figures to prove that the average household at $2 per month, using fifteen outlets, gives a yearly station income of only $40 per kw, while a forty-eight-lamp sign using 5-watt units, will, at 3 cents per kw-hr., return $55 per station kw. He urged that service and maintenance be furnished in addition to energy, on a flat rate, in order to keep the customer's sign useful and attractive to its owner.

Mr. T. W. Gregory, East St. Louis, pointed out that as sign loads come almost wholly on the peak they are less desirable than equivalent residence business. Mr. R. S. Wallace, Peoria, suggested analysis by comparing sign rates, on a basis of 1800 hours per year, with the average station income obtained by dividing the station peak by the gross revenue. Mr. E. W. Smith, Kewanee, showed that at 1 cent per connected watt an income of $120 per kw is obtained. With flat-rate service he finds that the customer maintains his displays readily enough.

INCREASING THE DAY LOAD.

Mr. C. L. Owen, Springfield, followed with his paper on "Merchandise Sales." In this he urged co-operation between all divisions of the same company and close personal contact between the sales, collection and complaint departments. An electric-iron campaign, placing 200 irons at $20 sales profit, will, he showed, result in $4,160 increased yearly income. In closing, he made a plea for more attractive show-window displays. Messrs. C. F. Snyder, Bloomington; T. W. Gregory, East St. Louis; J. G. Learned, Chicago, and G. R. Jones, Chicago, took part in the discussion.

Mr. D. Davis, Litchfield, took up the problem of increasing the motor load of the small company and advocated, when possible, employing a motor specialist familiar with isolated plants and their cost—a man able to interest prospective customers and capable of fully protecting his employer in a profitable contract. In small plants the manager must fit himself to perform this work. By spare-time attention, declared the author, he can gradually acquire an increased motor load without spectacular methods or special help.

A paper on "Street Lighting and Pumping for Villages and Cities," prepared by Mr. L. H. Haynes, East St. Louis, was abstracted by Mr. T. W. Gregory. The history of electrical illuminants was first traced, down to the modern flaming-arc, metallic-flame and tungsten lamps, with distribution curves, data, etc. Turning to water-supply subjects, the writer discussed various types of pumps and showed how electric motors might supplant steam operation to the advantage of both water and electric systems. Drainage and sewage lifting afford other pumping loads. The author recommended contracting on a kilowatt-hour rather than a gallons-pumped basis.

HOT-WATER DISTRICT HEATING.

A paper on "The Practicability of Central-Station Heating," by Mr. H. J. Frith, Watseka, was read by title at the opening of Friday's session. Mr. Frith discussed hot-water heating in particular and recommended that customers install ample radiation at the outset. He discussed in detail arrangements for condensing exhaust steam, heating water, etc. During 1911 the Watseka heating system in seven months paid 72 per cent of the total annual plant coal bill, and it will this year pay 90 or 100 per cent. Messrs. H. J. Pepper, Champaign; F. J. Baker, Chicago; E. H. Negley, Canton, and H. A. Foster, Fairbury, spoke briefly on steam-heating subjects.

LIGHTNING PROTECTION.

"Lightning Protection of Buildings" was the subject chosen for his address by Prof. E. J. Berg, of the University of Illinois, Urbana. Owing to the highly oscillatory character of the discharges, said the speaker, the conductor required for lightning rods is now to be regarded as quite independent of size, section or material, except for mechanical considerations. A good ground, on the other hand, is of the highest importance. Assuming a portion of charged cloud, 100 ft. square, 1000 ft. above a building of similar size, a condenser of 0.00001 microfarad is formed, whose energy at discharge will probably equal 11,200 kw-seconds, or about that of a pound of dynamite. Professor Berg also exhibited a table showing the drop per foot of length to be expected in a lightning conductor for various discharge frequencies. These figures, reproduced herewith, reveal good reasons for the "side-strokes" observed.

POTENTIAL DROP IN LIGHTNING CONDUCTOR FOR VARIOUS DISCHARGE FREQUENCIES.

Cycles.	Impedance, Ohms.	Amperes.	Drop per Foot, Volts.
100,000	0.1	15,000	1,500
300,000	0.5	75,000	37,000
1,000,000	1.0	150,000	150,000
5×10^6	25.0	750,000	1,800,000

For the protection of plant chimneys Professor Berg recommended a crown of discharge points grounded by several conductors, with bars crossing the opening through which the ionized and conducting gases pass.

"Recent Developments in Electric Meters," by Mr. H. W.

Young, Sangamo Electric Company, Chicago, described single and polyphase watt-hour meters, large-capacity direct-current meters, electric garage meters, electroplating meters, vehicle ampere-hour meters, distant dial meters, compensating meters for lead batteries, variable resistor meters, testing meters, graphic recording instruments, distant pressure recorders and meters used with electric weighing machines.

ELECTION OF OFFICERS.

In the executive session at the close of the technical session officers were elected as follows: President, Mr. J. J. Frey, Hillsboro; vice-presidents, Messrs. F. H. Golding,

PRESIDENT-ELECT J. J. FREY.

Rockford; E. MacDonald, Lincoln; F. W. Reimers, Rock Island, and E. H. Negley, Canton; treasurer, Mr. C. W. King, Lewiston; secretary, Mr. H. E. Chubbuck, Peoria; assistant secretary, Mr. C. A. Willoughby, Peoria; executive committee, Messrs. W. B. McKinley, Champaign; F. J. Baker, Chicago; R. S. Wallace, Peoria; E. W. Smith, Kewanee, and H. A. Foster, Fairbury.

Mr. J. J. Frey, the newly elected president of the Illinois Electrical Association, is president and general manager of the Hillsboro Electric Light & Power Company, Hillsboro, Ill. Mr. Frey entered the electrical field eighteen years ago and eight years later organized the Hillsboro company with a capital stock of $10,000. One of the pioneers in transmission work, especially in its methods of connecting up small towns, this company now operates 60 miles of 16,500-volt circuits, serving sixteen towns and 25,000 population. The system represents an investment of $800,000 and has a 2000-kw turbine plant, does exhaust-steam heating and operates a 30-ton ice plant. Mr. Frey is also president of the Collinsville (Ill.) Electric Company and is a member of the National Electric Light Association. Mr. Frey was born in Cincinnati, Ohio, in 1867, and moved to Hillsboro at the age of twelve years. In 1889 he entered the real-estate business in Hillsboro. He has maintained his interest in real estate to the present date and is prominently identified with several of the locally owned enterprises.

In addition to special entertainment features for the ladies, the entire convention enjoyed a banquet at the Hotel Jefferson Wednesday evening. Mr. C. W. King presided as toastmaster, and the Hon. P. G. Rennick was the speaker of the evening. On Thursday night several excellent professional vaudeville numbers were followed by a minstrel show given by some of the associate members present, Mr. C. W. Wilkins officiating as interlocutor.

DECISION IN MALDEN STREET-LIGHTING CASE.

Upon the petition of the Mayor of Malden, the Massachusetts Gas and Electric Light Commission has investigated the rates for street lighting charged by the Malden Electric Company and has recommended reductions as stated below. The contract between the city and the company expired in June, 1911, and the rates in effect before the finding of the board were $96 per year per 6.6-amp, 430-watt alternating-current inclosed-arc lamp; $20.80 for each 50-watt tungsten lamp operated all night and every night, and $18.30 for each similar incandescent lamp run on a dark-hour schedule of about 3100 hours per year. The installation consists of 123.5 arc lamps (one lamp being on the city boundary), twenty-three all-night tungsten lamps and 1172 dark-hour incandescent lamps. The arrangement covered by the contract has continued in force since expiration, but the company offered, prior to the filing of the petition, to make a ten-year contract for the foregoing types of lamps in all-night and every-night service at a price of $86.40 per arc lamp and $18.72 per incandescent lamp per year, provided the equipment then in use was not curtailed. This proposed price was reached by deducting 1 per cent from the base prices of $96 and $20.80 for each year that the contract might run.

In the course of the investigation the city authorities requested that if the board should find present prices too high it would determine what the city ought to pay for a 310-watt magnetite-arc lamp run upon an all-night and every-night schedule. The board ruled that it has authority under the complaint and the statute applicable thereto to reduce an existing price, but not to determine the type of lamp which the city should use nor to establish a rate for a distinctly new and non-existent service for which no rate had been made by the company. No attempt was made by either party to demonstrate the fair price of street lighting on the basis of the cost of the particular service, and, as in the recent Worcester street-lighting decision, abstracted in our issue of July 27, page 190, it appears to the board neither practicable nor desirable in the present development of the company's business to undertake a determination admittedly theoretical of the cost of supplying the street lamps apart from the other costs of the company's business.

The board says, however, that "consideration may be given to the fact that certain lines, lamps and fixtures are used and that certain operating expenses are incurred exclusively in the street-lighting service, and that there are elements of investment and maintenance cost per unit which are peculiar to this system as distinguished from the strictly commercial business of the company. At the same time, the street-lighting system has perhaps the best load-factor of all the customers, and if differentials from the maximum price to private customers are to be made because of differences in load-factor, the street-lighting may reasonably be entitled to the same kind of consideration. The board is of the opinion furthermore that the street lighting is so intimately associated with the other parts of the company's business that prices for street lamps should not be fixed without some consideration of the conditions surrounding the entire business of the company, and that in this case the city should not be charged more for the electricity required to operate its incandescent street lamps than the maximum net price charged private customers."

The company supplies four residential suburbs of Boston, but a considerable industrial activity obtains in its field. The book value of the plant on June 30 last was $1,289,057, with other assets of $174,815, against which the company had outstanding stock of $525,000, bonds of $100,000, notes and other debts amounting to $463,022. In the past five years the annual net earnings from operation available for interest, dividends and depreciation have increased from $84,611 to $125,439, and an extra dividend was declared in 1912, although the depreciation charges rose from $4,952 to

$17.752 in the period covered. During this time the price for street lighting remained unchanged, while the company reduced its maximum net rate from 15 cents to 11 cents per kw-hr. The commission finds that these reductions have caused the company no embarrassment, and states that while the company is entitled to a fair return upon the property actively and necessarily used for the public convenience, the income from its entire business is ample to justify the extension to the street-lighting rates of the same policy of price reduction that it has applied to its commercial output.

DISCUSSION OF MASSACHUSETTS COMMISSION IN NATICK RATE CASE.

Upon complaint of customers of the Natick Gas Light Company, the Massachusetts Gas and Electric Light Commission has issued an order reducing the price of gas to $1.50 per 1000 cu. ft., as of Dec. 1, 1912. The company serves a municipality of about 10,000 inhabitants lying 18 miles west of Boston and competes with the Boston Edison company in the lighting field. For many years prior to 1900 the company maintained a differential rate for the larger consumers only slightly below the maximum net rate. In that year, with a maximum net rate of $1.90 for gas for lighting, a special net rate of $1.50 was made for power and cooking purposes. As a result of this policy the sales increased from 1,500,000 cu. ft. to 7,500,000 cu. ft., practically all the gain being in gas sold at the $1.50 rate. Following a suggestion of the board in 1908 the company reduced the maximum net price to $1.70, and in 1910 to $1.65. At the same time the annual dividends rose to 6.5 per cent. The policy of decreasing the maximum net price until a uniform price for all purposes should be reached was being steadily pursued and proved a recognized benefit to the company and the public. Considerable dissatisfaction, however, arose from the use of a differential favoring the use of gas for stoves.

In 1911 the company passed into the hands of new owners, and in pursuing the policies of the latter the operating costs were increased. As a reduction of the maximum net price for lighting purposes seemed to the management to give no reliable promise of the additional income desired, the rate for gas-stove use was advanced to the maximum net price, although the rate for manufacturing purposes was not disturbed. This action led to the complaint.

The board said: "Evidently this advance in price has failed to provide the income sought to meet the changed conditions in the company. In the two years ended June 30, 1912, while meter sales for all purposes increased by only about 300,000 cu. ft. and the receipts therefrom less than $1,000, the operating profits decreased nearly 50 per cent. It has become evident that if the reasons for the first advance were sound another advance may now with equally good reason be demanded.

"Even if it be within the board's province, it is unnecessary to discuss at this time the expediency of the particular changes in method to which the additional costs under the present management are attributable. . . . That a profit reasonably satisfactory to the former management was possible at the rates then existing has been amply demonstrated, nor is it likely that these profits would have been seriously or permanently disturbed by further reductions of the maximum net rate in harmony with the suggestions of the board. . . . It was probably due to the expectation of an early attainment of a uniform price that the discriminatory conditions which have been described were allowed to develop. It is not unlikely that these conditions had become sufficiently fixed so that they could be cured in no other way.

"In considering the purchase of the company and the introduction of the new-business methods, the foregoing considerations ought not to have been overlooked by the new owners. It was their privilege to assume the risks incident to the course pursued, but an attempt arbitrarily to impose the unfortunate results upon the public would probably not have been made except for the possession of a monopoly. Operating as well as investment expenditures should be directly related to the needs and conditions existing in the community. Unnecessary expenditure in either direction must be at the risk of the owner. He is bound to have due regard to the needs and reasonable demands of the community to be supplied when deciding upon the necessity or advisability of expenditures proposed. A reasonable return presupposes reasonable costs, and reasonable costs are determined by a consideration of all the conditions surrounding the business. If a company's methods and general policy be unreasonably costly or so obviously unwise as to decrease its earning power or check the growth of its business, these things may be of great importance in determining the amount of a reasonable return. Some of the recent increases in operating costs are probably temporary only and may not again occur. The reasons for increasing the expenses were insufficient to justify them if thereby it became necessary to advance the price. . . . The price which is named is sufficient to yield a reasonable return upon the property actually and necessarily employed."

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION.

The Public Service Commission for the First District on Oct. 26 started work on the extension of the Fourth Avenue subway in Brooklyn, contracts for which were recently let to the Degnon Contracting Company. Ground was broken in Fourth Avenue near Bay Ridge Avenue, and the people of South Brooklyn celebrated the event with a parade and formal ceremonies, during which Chairman William R. Willcox of the commission, Borough President George McAneny of Manhattan, Borough President A. E. Steers of Brooklyn and others made addresses. The new work is in great part a four-track subway, extending from the present terminus of the Fourth Avenue subway at Forty-third Street and Fourth Avenue down the latter thoroughfare to Eighty-ninth Street. It will cost upward of $3,000,000. The completion of this work will do much to develop territory which has lacked adequate transportation facilities.

MASSACHUSETTS COMMISSION.

A petition has been addressed to the Gas and Electric Light Commission by Mayor Barry of Cambridge asking for an investigation of the prices charged for electricity by the Cambridge Electric Light Company.

The board has handed down a decision reducing the price of street lighting in the city of Malden from $96 to $85 per 6.6-amp arc lamp per year; from $20.80 to $18 per 50-watt incandescent lamp burning all night and every night, and from $18.30 to $15.50 per 50-watt tungsten lamp burning not less than 3100 hours per year, dating from Nov. 1, 1912. An abstract of the board's decision appears in another column.

A decision has also been issued by the commission reducing the price of gas in the territory of the Natick Gas Light Company to a maximum of $1.50 per 1000 cu. ft. The case involved the consideration of a differential in the rates for lighting, domestic heating and industrial service, and the relation between changes in rates, the income and responsibility for financial risks in a public utility. A digest of the board's finding is given elsewhere.

MARYLAND COMMISSION.

The Maryland Public Service Commission last week ruled that the Chesapeake & Potomac Telephone Company must adopt the word "Postal" as a call word for the Postal Telegraph and Cable Company and the words "Western Union" as a call word for the Western Union Telegraph Company. This action was taken as a result of a complaint filed by the Postal company against the telephone company, alleging that the use of the word "Telegram" as a call for the Western Union Company and the word "Postal" for the Postal company had resulted in the diversion of Postal calls to its competitor by the telephone company, the parent company of which controls the Western Union company. A similar case before the New York commission some months ago was likewise decided in favor of the Postal company. The hearings in the case before the Maryland commission were marked by intense feeling between the representatives of the two companies.

A report recently submitted to the Maryland commission by Chief Engineer Charles E. Phelps is said to show that the saving to telephone subscribers of the Chesapeake & Potomac Telephone Company by reason of the new rate order by the commission is more than 20 per cent. The actual saving to subscribers is estimated to be $109,945 for the period from Jan. 1 to Oct. 1.

OHIO COMMISSION.

Permission has been denied the Union Gas & Electric Company of Cincinnati to issue $500,000 additional stock with which to make good a shrinkage in the securities deposited under the terms of its lease of the properties of the Cincinnati Gas & Electric Company. City Solicitor Bettman opposed the increase on the ground that the capital obligation would be augmented without any addition to the value of the property. When the lease was executed the Union Gas & Electric Company agreed to secure its contract by the deposit of $3,300,000 in securities. Bonds of the Columbia Gas & Electric Company, a holding corporation, were deposited, and it is claimed that they have declined in value until they are now worth only $2,700,000. The proposed stock issue was to be exchanged for additional bonds to cover the difference.

The commission has notified the Canton Electric Company, Canton, to have its representatives appear on Nov. 14 to explain how it is able to allow discounts of from 20 to 50 per cent on bills paid within ten days from date. The commission has been furnished with a schedule of rates and discounts as follows: More than $1 and less than two hours' daily average use, 10 per cent; more than $2 and less than two hours' daily average use, 20 per cent; $3 and less than three hours' daily average use, 30 per cent; $4 and less than four hours' daily average use, 40 per cent; $5 and less than five hours' daily average use, 50 per cent. These rates, members of the commission say, are made to encourage prompt payment of bills, but the difference is too great when the amount is doubled if the payment is late.

Authority to make a new issue of $200,000 of old bonds was denied to the Defiance Gas & Electric Company, Defiance, on the plea that the mortgage securing the issue is faulty. The company had in addition asked that $90,000 additional bonds, to be sold at 80, and $90,000 stock, to be sold at 60, be authorized. The commission found that the mortgage was not faulty and that the sale price of the bonds and stocks fixed in the petition was too low.

WISCONSIN COMMISSION.

The Wisconsin Railroad Commission, in accordance with its policy of preventing destructive competition between utilities, has denied the application for a certificate of convenience and necessity petitioned for by the Interstate Light & Power Company. The petitioner maintains a central station at Galena, Ill., and supplies electrical energy to certain sections of Illinois and southern Wisconsin through the medium of its high-tension transmission system. It sought permission to invade a territory which is without electric service at the present time, but which is claimed by the Mineral Point Electric Light Company as its exclusive territory by right of a permit received from the Town Board. It appears that the latter company, a reorganized one, had received authority to extend its service into the disputed territory and was at the time of the hearing engaged in the preliminary work incident to such extension and to the necessary rehabilitation of its plant. The petitioner alleged that it had contracted to supply energy to certain mines operating in the district desiring electric service immediately and was in a position to do so upon the granting of the certificate. It was averred that the complainant could not claim the territory inasmuch as it was not operating therein, and that, furthermore, the Mineral Point company did not have the necessary station capacity to take care of the added load and did not have a bona fide intention of extending its service as claimed, but only intended to secure permits to prevent the petitioner from extending its operations. The commission held that a company must secure a permit to do business before it can engage upon the construction of its system and that therefore the protection of the law must necessarily extend to cover a contemplated construction. After an investigation by the engineering department, the commission held that both companies were in position to furnish service within a comparatively short length of time; that there was not sufficient business in the district to justify the existence of two utilities; that, inasmuch as the local company was carrying out its plans of extension and rehabilitation as rapidly as could reasonably be expected, it was entitled to the protection provided by law, since public convenience did not require the service of more than one utility.

The commission has ordered a physical connection to be made between the exchanges of the Clinton Telephone Company and the Bergen Telephone Company, with a tentative arrangement for compensation. It appears that the two utilities had exchanged free service up to April, when, on account of the inability of the companies to make a further agreement for exchange of service, the lines were disconnected. The Clinton Telephone Company objected to a free exchange of service on the ground that it has about six times as many subscribers as the Bergen company and that in exchanging free service it would be giving much more than it received. From a test made upon the systems before the disconnection it appeared that the number of calls each way was about the same, so that as far as the amount of business was concerned the exchange would be of no more benefit to one than to the other. Even if the number of calls each way had not been the same, the service would not necessarily be of more value to one exchange than to the other, in the commission's opinion, inasmuch as the service has a value to the party called as well as to the party calling. The commission did, however, lay down the principle that if it cost one company more than it did the other to furnish the interchange of service it would not be reasonable to require the interchange on equal terms, but that rates should be charged which were based upon the cost of such service. In the present case there were no facts available to indicate that the cost would be greater to one company than to the other, nor was there any way to determine to what the cost to each would amount. To determine an equitable toll rate it will be necessary to make a study of the actual operating conditions with toll rates in force. The commission, therefore, ordered a physical connection to be made, with a tentative toll charge of 2 cents per completed call, and with total toll revenues divided equally between the two exchanges. The order was issued with the understanding that if experience shall show that the toll rates as fixed, or the division of revenue, needs revision, the matter may be reopened.

Current News and Notes

LONG RANGE FOR ELECTRIC AUTOMOBILE.—A noteworthy trip of an electric automobile was that from Detroit to New Orleans, a distance of 1700 miles, as pathfinder for the 1912 "Glidden Tour," made by a four-passenger Flanders coupé equipped with a Willard battery. The successful run of this car according to a previously arranged schedule, should do much to establish confidence in the possibilities of the electric vehicle for touring.

* * *

ONTARIO HYDRO-ELECTRIC COMMISSION WANTS CONTROL OF STREAMS AND CANALS.—At a meeting at Belmont on Oct. 23 the Hon. Adam Beck, chairman of the Ontario Hydro-Electric Commission, stated that a friendly suit will be started against the Dominion government in an endeavor to secure for the commission control of all rivers in the Province of Ontario and the surplus water in the canals. This, he said, was part of the Hydro-Electric scheme.

* * *

MISSISSIPPI RIVER POWER DEVELOPMENT.—The Mississippi River Power Company's complete development at Keokuk, Ia., is shown in a fine lithograph 38 in. wide by 14½ in. long recently published by the company. This hydroelectric plant of 200,000 electrical hp will be completed, it is estimated, in July of 1913. The picture will appeal to all who have been interested in this very important installation, to which frequent references have been made in these columns.

* * *

"METERMAN'S HANDBOOK."—Secretary T. C. Martin, of the National Electric Light Association, reports that the "Meterman's Handbook," published by the association for its members in June of the present year, has already gone through two editions. The first edition of 1000 was almost immediately disposed of and a second edition of 1500 copies went very rapidly. An order has just been placed for a third edition of 2500 copies. The value and popularity of this important work are thus clearly demonstrated.

* * *

EXTENSIONS OF ONTARIO HYDRO-ELECTRIC SYSTEM WANTED.—Because of the fact that a gas-producer plant installed by the municipality some time ago has not proved satisfactory, the village of Glencoe, Ontario, 30 miles west of London, has arranged through an industrial committee with the Hon. Adam Beck, chairman of the Ontario Hydro-Electric Commission, for a conference concerning the possible use of electrical energy from Niagara. The lines of the Ontario Hydro-Electric system at present extend only as far as London, but many other places to the west are anxious to have the service.

* * *

RESUSCITATION CHART.—*Grit*, a well-known weekly published at Williamsport, Pa., is now planning, so it is reported, to make a novel and practical use of the resuscitation chart of the National Electric Light Association. Local physicians will be asked for expressions of opinion on the best means of using the resuscitation chart for the benefit of the general public and how best to educate laymen generally in this method of resuscitating victims of electric shock. These opinions will be published and will have as much publicity as possible. *Grit* is reported to have a circulation of upward of 300,000.

* * *

KENTUCKY PUBLIC UTILITIES BILL.—Central-station men in Kentucky are much interested in the movement which has been started to secure a special legislative session in the Bluegrass State for the purpose of considering a public utilities bill. This measure has been considered in the commonwealth for some time, with a view toward the establishment of a commission to have jurisdiction over the public service corporations of Kentucky. Various members of the State administration are urging upon Governor James B. McCreary at Frankfort the necessity of a special session of the Assembly to dispose of this and other measures.

* * *

PAYMENT FOR STREET LIGHTING.—Electric-service companies complain sometimes that municipalities are slow in paying for street lighting. It seems that the same complaint may arise where one municipal corporation serves another. The Sanitary District of Chicago cares for the street lighting of the city of Chicago under contract, and it has been proposed that the city double the requirement for new arc lamps, taking 20,000 instead of 10,000, as at present under contract. But the District trustees ask where the money is coming from. According to newspaper report, Trustee Sullivan explained that on Oct. 22 the city owed the District $84,000. He said that the city should show its ability to pay for additional lamps before a new contract is signed.

* * *

BOSTON ELECTRIC SHOW.—The Boston 1912 Electric Show closed its doors on the evening of Oct. 26 after a highly successful run of four weeks. About 500,000 persons visited the exhibits, many making the journey from across the continent, while visitors from the other side of the ocean included the display in their trip to the country. Numerous special excursions were run to Boston from all parts of New England, and central-station men returning homeward bear evidence to a striking increase in popular interest in electrical applications. The electric vehicle exhibit, in particular, made a profound impression upon the general public, for more and better machines of this type were displayed in a compact area than at any previous show. The latest developments in electric lighting and in commercial electric heating also aroused great enthusiasm.

* * *

INVESTIGATION OF LONDON (ONT.) STREET LIGHTING.—Mr. Harry Angus, of the School of Practical Science, of Toronto, Ont., has been engaged by the special committee of the London (Ont.) City Council which has been delegated to investigate the cost of street lighting in London. Mr. Angus will prepare a detailed report. A controversy arose, it is reported, when Alderman J. G. Richter claimed that the Hydro-Electric Commission is charging the City Council an excessive rate and that the scale is out of all proportion to domestic lighting. Chairman Philip Pocock and the Water and Light Commission left the matter with the Ontario Hydro-Electric Department to decide, and a decision favorable to the body of which Mr. Pocock is head was presented. Alderman Richter was still dissatisfied, however, and will now obtain an independent report.

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SEATTLE LIGHTING RATES.—In a letter to the *Journal of Electricity, Power and Gas*, Mr. W. J. Grambs, superintendent of light and power of the Puget Sound Traction, Light & Power Company, questions the correctness of published statements regarding the rates of the Seattle municipal plant. In these statements, Mr. Grambs says, it is made to appear that when the city plant first began to operate in 1904 the competing company had a rate of 20 cents per kw-hr., and that this rate was later reduced to 12½ cents per kw-hr., based on the connected load. "The rate," Mr. Grambs says, "was only 20 cents per kw-hr. for the first thirty hours' burning of the maximum demand, after which the rate dropped to 5 cents per kw-hr., with a discount of 10 per cent. Likewise, this company never had a rate of 12½ cents—the rate was 12 cents for the first sixty hours' burning of the maximum demand and 3 cents for all excess, with a discount of 10 per cent."

Opposition to Louisville Central Station Consolidation.—Briefs are to be filed at once in the Chancery Court in Louisville, Ky., in the case of the municipality versus the Kentucky Electric Company. The city seeks to enjoin the Kentucky company from disposing of its stock to outside interests, such as H. M. Byllesby & Company, on the ground that such action would constitute a violation of the company's franchise. Attorneys for the Kentucky Electric Company recently appeared before Judge Samuel Kirby in the Chancery Court, arguing the demurrers to the injunction suit.

* * *

Railway Electric Supply Manufacturers' Association.—During the convention of the Association of American Railway Electrical Engineers in Chicago on Oct. 24 the allied Railway Electric Supply Manufacturers' Association elected officers as follows: President, Mr. Godfrey H. Atkin, Electric Storage Battery Company, Chicago; vice-president, East, Mr. C. W. Bender, National Electric Lamp Association, Cleveland; vice-president, West, Mr. W. F. Bauer, United States Light & Heating Company, Chicago; treasurer, Mr. Edward Wray, Chicago; executive committee, Messrs. R. M. Newbold, Adams & Westlake Company; J. M. Lorenz, Central Electric Company; Otis B. Duncan, George Cutter Company; W. E. Ballatine, Willard Storage Battery Company; J. G. Van Winkle, Safety Car Heating & Lighting Company; B. L. Winchell, Jr., Kerite Insulated Wire & Cable Company; George H. Porter, Western Electric Company; L. J. Kennedy, Consolidated Railway Electric Lighting & Equipment Company.

* * *

Western Union Telegraph Company Seeks to Retain Louisville & Nashville Railroad Right-of-Way.—The Western Union Telegraph Company in Kentucky won a preliminary victory a few days ago in the federal court in Louisville, presided over by Judge Walter Evans, in the first of a series of legal skirmishes between the telegraph company and the Louisville & Nashville Railroad Company. The railroad company, after using Western Union telegraphic service for many years, decided upon the termination of its contract on Aug. 17 last and determined to equip and operate a private system for train dispatching and general commercial service in the South. The Western Union company has fought this action, seeking to establish its right to the use of the railroad's right-of-way. A petition was filed in the federal court asking that this right be allowed and, in preliminary proceedings, Judge Evans overruled demurrers as to jurisdiction and to the petition generally which had been filed by the railroad legal department.

* * *

Fuel Briquetting.—The subject of fuel briquetting is treated in a short pamphlet recently issued by the United States Geological Survey, Department of the Interior. This bulletin is an advance chapter from "Mineral Resources of the United States, 1911," prepared by Mr. Edward W. Parker, and contains an account of the progress made in the United States in the manufacture of fuel briquettes. Although some progress was made in the development of fuel briquetting in the United States during 1910 and 1911, this country still lags far behind several of the European countries, particularly Germany. In 1911 there were twenty-one plants in the United States which manufactured compressed fuel, an increase of five over 1909. Four of these plants were operated only for experimental purposes. Of those which operated on a commercial basis eight employed anthracite as the raw material, two used bituminous coal, two utilized semi-anthracite, one employed refuse from oil-gas works, one utilized peat and three used mixed materials. The production of briquettes in the United States during the year 1911 was 218,443 short tons, having a value of $808,721. The pamphlet concludes with a list of the plants operating in the United States.

Commercial Creosotes.—Creosotes may be produced from a variety of tars, among the more important of which are coal tar, oil tar and wood tar. The important coal tars are derived from the destructive distillation of bituminous coal at high temperature, as in the manufacture of coal gas, and from the combined distillation and combustion of bituminous coal at comparatively low temperatures, as in gas producers. The most important source of oil tar is found in the manufacture of carbureted water gas, from which the so-called "water-gas" tar is obtained as a by-product. Oil tar is also produced by the destructive distillation of crude petroleum in the manufacture of oil gas. Wood tar is produced in a manner somewhat similar to that in which coal-gas tar is obtained, where wood is destructively distilled in air-tight retorts for the production of charcoal and by-products. Creosotes may be produced from any of the foregoing tars by the same general process, which consists of distillation in a metallic retort or still. Those distillates which are heavier than water form the true creosotes used in wood preservation. Creosotes are generally obtained at distillation temperatures lying between 200 deg. and 360 deg. C. The value of any creosote as a preservative against decay depends upon its ability to prevent the development of wood-destroying fungi. This prevention may be secured either by introducing a material sufficiently poisonous to prevent the development of fungi or by introducing sufficient material to exclude moisture or air to a degree below that required for the development of fungi. Circular 206, lately issued by the Forest Service of the United States Department of Agriculture, entitled "Commercial Creosotes—with Special Reference to Protection of Wood from Decay," by Mr. Carlile P. Winslow, describes the composition and properties of creosotes and also contains notes on its prices and consumption in the United States. In 1910 the total consumption was 63,000,000 gal., in round numbers, of which 45,000,000 gal. was imported from abroad and 18,000,000 gal. produced by manufacturers in this country.

* * *

SOCIETY MEETINGS.

Weekly Luncheons of Electric-Vehicle Men in Chicago.—The Chicago Section of the Electric Vehicle Association of America will meet informally at luncheon every Tuesday in the Delft Room, College Inn, Hotel Sherman, from 12:30 to 2 p. m. The first of these luncheons was held on Oct. 29. Mr. W. J. McDowell, of the Chicago office of the General Vehicle Company, is the secretary of the section.

* * *

American Society of Mechanical Engineers.—On Tuesday evening, Nov. 12, at 8:15, the American Society of Mechanical Engineers will hold its regular monthly meeting, on which occasion a paper entitled "Measuring Efficiency in Manufacturing" will be presented by Mr. Edward B. Passano, of Baltimore. This paper will set forth a number of novel ideas in connection with this important branch of economics. According to the published announcement an informal dinner will precede the meeting.

* * *

Joint Meetings in Chicago.—The next joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers will be held at the rooms of the latter on Nov. 25. Two papers relating to storage batteries and their uses will be presented—one by Mr. J. L. Woodbridge, chief engineer of the Electric Storage Battery Company, and the other by Mr. H. H. Smith, of the Edison Storage Battery Company. At the December joint meeting Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, will present a paper descriptive of the new Northwest station of the Commonwealth Edison Company of Chicago.

ELECTRIC SERVICE IN COAL REGIONS.

Description of the Features Characterizing the System of the Luzerne County Gas & Electric Company of Kingston, Pa.

Electrical Energy Transmitted to Fourteen Boroughs in the Wyoming Valley from Steam-Driven Station at Plymouth—Territory Free from Municipal Plants—Large Connected Load Among Anthracite Mines in the Vicinity.

THE Luzerne County Gas & Electric Company, of Kingston, Pa., as at present constituted is a consolidation of a former company of the same name with the Wyoming Valley Gas & Electric Company. The two properties were combined in 1908 by the American Gas Company, of Philadelphia, Pa., which company still manages and controls the system. Gas and electric energy are distributed in the boroughs of Plymouth, Nanticoke, Kingston, Edwardsville, Dorranceton, Luzerne, Courtdale, Forty Fort, Wyoming, West Wyoming, Swoyerville, Shickshinny, Dallas and Larksville. Gas is distributed also in the boroughs of Hazleton and West Hazleton, where an isolated property is owned and managed from the main office at Kingston. The electrical distribution circuits of the company extend into the townships of Newport, Plymouth, Hanover, Kingston, Jackson, Hunlocks and Union, and the population served aggregates 150,000. This territory for a number of years abounded with small municipal plants, the last three of which—those at Forty Fort, Wyoming and Shickshinny—have been displaced within the past few years, so that at the present time there are no municipal lighting plants in the 30 square miles served by the company.

A feature of the load connected to the Luzerne County Gas & Electric Company's system is the large number of mining installations fed with central-station energy. The connected mining load is approximately one-third of the total load on the system. This business is obtained chiefly from mine operators with smaller holdings who find operation with central-station service more advantageous than by isolated plants with cheap fuel but heavier investment cost. While the hoisting load incidental to coal mining is not altogether desirable from a central-station viewpoint because of its great peak demand and intermittent character, the service required for operating the major part of the machinery in the breakers and also for operating the pumps and fans is steady in demand, and the latter, moreover, is generally of twenty-four hours' duration, so that the load-factor of the installation is high, while that of the generating system is materially improved.

Coal throughout the region is comparatively cheap, selling for steam-raising purposes at from $1.10 to $1.30 per ton delivered. Coal-mining companies usually burn refuse and screenings, the cost of which is almost nil, and it has been seriously proposed on more than one occasion to erect huge generating stations at the mouth of coal mines and transmit the electrical energy to neighboring cities, thereby eliminating coal haulage. Usually the scarcity of water

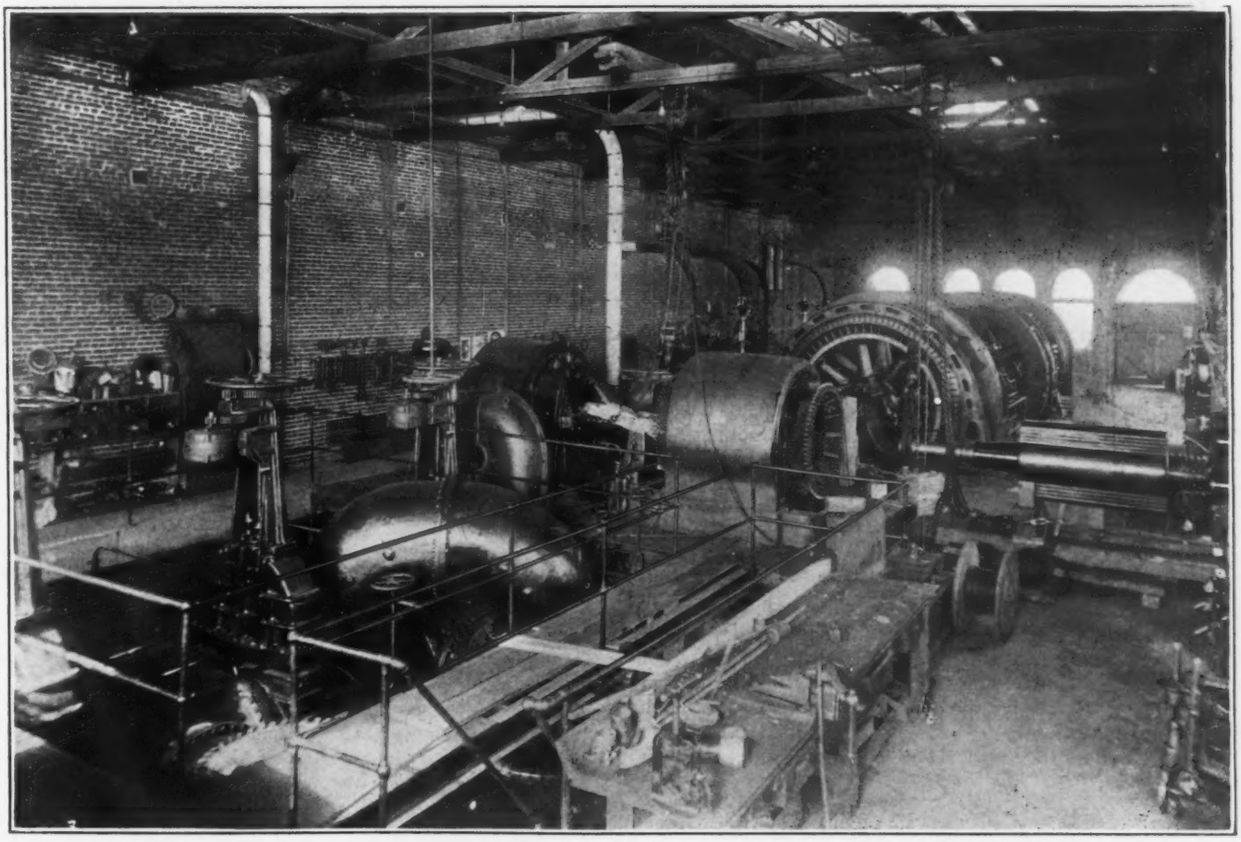


Fig. 1—Exhaust Steam-Turbine and Reciprocating-Engine Units in Station of Luzerne County Gas & Electric Company.

for steam-raising purposes has proved an obstacle to such development, yet in some localities possessing abundant water supply the scheme after investigation has not disclosed the large savings anticipated. The Luzerne County Gas & Electric Company's system serves as an example in which the scheme has been reversed, the company purchasing fuel at market prices from nearby mines, converting its heat energy into electrical energy, and then disposing of the energy to the mining operators to the mutual advantage of both.

STEAM EQUIPMENT.

The generating station is located on the west bank of the Susquehanna River at Plymouth, Pa., where ample water supply is always available for condensing purposes. The site is in the heart of the coal-mining region, so that abundant fuel is readily obtainable at a very low rate. Within the past two years the station has undergone a process of reconstruction to meet the growing needs of a progressive community. The steam equipment at present installed comprises two 500-hp, two 250-hp Keeler boilers and six Vulcan boilers rated at 100 hp. Buckwheat coal, No. 3, is burned in the boiler furnaces on shaking grates, the boilers being connected to a balanced-draft system installed by the Combustion Engineering Company of New York. The coal is brought to the station in carts and stored in a concrete inclosure running parallel to the boiler room and

Fig. 2—Power House, Showing Nearby Culm Banks and Coal-Storage Bins.

having a capacity of 4000 tons. A motor-driven conveyor delivers the coal to the boiler room. The conveyor system traverses the entire length of the coal pile at a height of about 8 ft. above the boiler-room floor and deposits its load in hoppers outside the station wall, which discharge the contents through openings onto the boiler-room floor.

At the present time the ashes are removed from under the boiler by hand and carted away. The company has under contemplation the erection of an ash-handling system whereby the ashes will be deposited in a pipe line and blown into a receiving tank outside the station by means of a steam jet. From this tank the ashes will be removed by means of a motor-driven truck and used for filling-in purposes. Water for boiler-feed purposes is taken from the city water mains.

Fig. 3 is a view of the boiler room, showing the method of depositing coal on the floor and also a 50-hp motor-driven fan employed in the balanced-draft system. There are eight radial steel stacks connected by breeching to the ten boilers. Steam for the generating equipment is supplied through a header loop made up of 16-in. steel pipe, the connections to the header being made through 6-in. and 8-in. valves.

GENERATING EQUIPMENT.

The generating equipment consists at the present time of three 500-kw, 2300-volt, two-phase, 60-cycle Westinghouse and Allis-Chalmers units. These are directly connected by Hamilton-Corliss engines built by the Hooven-Owens Rentchler Company, of Hamilton, Ohio. The units were operated non-condensing up to about two years ago, when an 1800-kva Westinghouse low-pressure turbine was installed. This latter unit receives the exhaust steam from the three engines. The generator is wound for two-phase,

Fig. 3—View of Boiler Room.

60-cycle, 6600-volt service. Last January a 3000-kva Westinghouse high-pressure turbo-generator wound for two-phase, 6600-volt, 60-cycle service was installed, and the company has now on order another 3000-kva unit, which it is expected will be in operation before the first of the year. Both the low-pressure and the high-pressure turbine are equipped with Westinghouse Le Blanc condensers mounted on a concrete base beneath the turbine floor. One of the pump units, comprising a circulating pump and a special dry vacuum pump mounted on the same shaft, is driven by a 125-hp Westinghouse polyphase motor, and the other unit is driven by a 125-hp Westinghouse steam turbine. Excitation energy for the generator equipment is supplied by two 40-kw Bullock engine-driven sets and one 40-kw Westing-

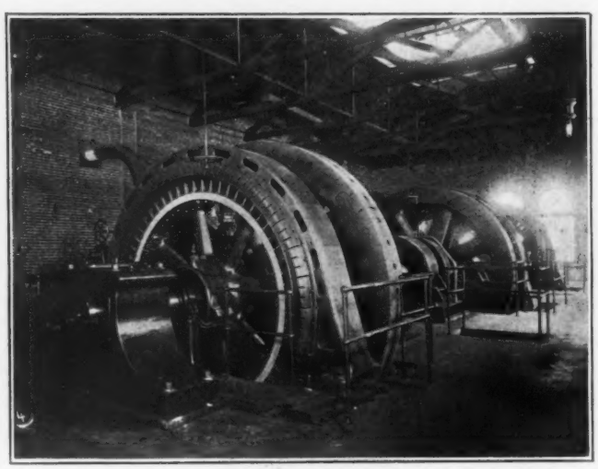


Fig. 4—Reciprocating-Engine-Driven Units in Plymouth Station.

house motor-driven set. At the present time all of the load is carried by the high-pressure turbine unit, the reciprocating engine-driven sets being held in reserve.

Water for condensing equipment is taken from the Susquehanna River by means of a vertical motor-driven centrifugal pump located on the bank of the river about 200 ft. from the station. The motor driving the centrifugal pump is rated at 50 hp.

CONTROL.

All of the main 6600-volt and 2300-volt switches are electrically operated from the switchboard, which is made up of twelve standard panels. Each generator is controlled through a General Electric oil switch and a circuit-breaker, and a second set of breakers controls the connections to the transformer buses. Two 600-kw transformer banks and one 250-kw transformer bank step up the potential from 2300

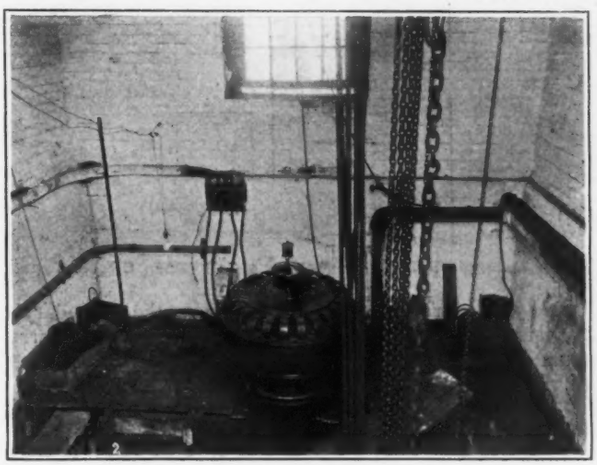


Fig. 5—Interior of Pump House, Showing 50-hp Motor Attached to Centrifugal Pump.

volts to 6600 volts for transmission. Of course, with the high-pressure unit in operation the step-up transformers are not in service. The two outgoing lines are protected by electrolytic lightning arresters.

TRANSMISSION LINES.

Transmission lines at 6600 volts run north and south in the Wyoming Valley from the station for distances of 12 miles and 14 miles respectively. The lines are carried on chestnut poles spaced 150 ft. apart, standard 35-ft. poles with 8-in. tops being employed. A view of the transmission line running along the bank of the Susquehanna River is

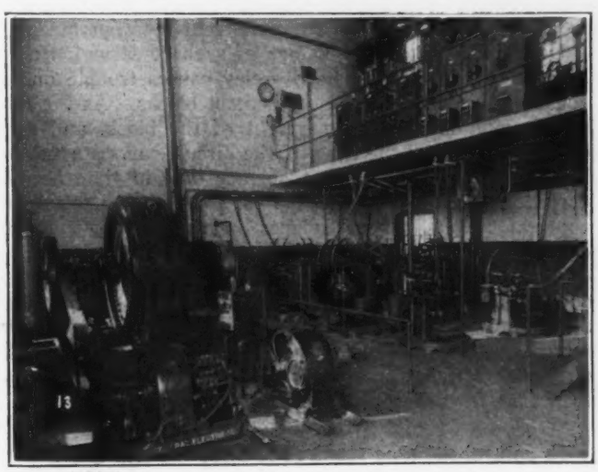


Fig. 6—Synchronous Motor and Transformers in Kingston Substation.

shown in Fig. 7. From this line a number of the coal mines en route are supplied with electrical energy.

SUBSTATIONS.

Substations are located at Kingston, Nanticoke, Forty Fort, Wyoming and Shickshinny. The standard high-tension equipment consists of oil switches for opening the main line, oil switches for leads on the transmission and a set of electrolytic lightning arresters. The substations at Nanticoke, Forty Fort, Wyoming and Shickshinny are merely transformer stations which step down from 6600 volts to 440-220 volts for local distribution. The largest substation on the system is located at Kingston and has a maximum rating of 1000 kw. The equipment comprises two 300-kw step-down transformers, three 100-lamp, one seventy-five lamp and two fifty-lamp constant-current transformers and a 400-kw synchronous motor floating on the system for power-factor corrective purposes.

Electrical energy for industrial service is distributed and sold at 2300, 440 and 220 volts. In the territory served there are several large industrial plants in addition to the coal-mining installations previously mentioned. These include silk and hosiery mills, planing mills, pumping plants, etc.

The company has enjoyed a steady increase in its residential and other commercial lighting business, particularly in the Kingston district, which place is now one of the principal residential sections of the Wyoming Valley. A recent canvass on heating devices disclosed the fact that there are few homes which are not now using an electric iron or other heating device.

The regular rates for motor service are based on the maximum-demand system, with a substantial discount which permits the long-hour user to obtain a very attractive rate. For lighting the rate is 10 cents per kw-hr., with discounts

Fig. 7—Line Construction.

of from 10 per cent to 25 per cent on amounts of from $1 to $15. The minimum charge for motor service is $1 per hp per month, and for lighting 50 cents per meter.

The following officers compose the personnel of the company: Mr. William C. Anderson, manager; Mr. A. J. Llewellyn, superintendent; Mr. T. E. Spence, contract agent, and Mr. L. C. Bradbury, accountant.

TRANSFORMERS FOR DREDGING OPERATIONS.

In connection with the transformer barge which supplies energy for the dredging operations in the Mississippi River at East St. Louis, as described in our article of Oct. 5, one of the engineers who designed the installation has since suggested the ballasting advantage of dividing this equipment into two sets, each of one-half the total rating, in order to secure better stability of the float. When mounting heavy machinery on barges this practical feature of loading and ballasting becomes important. Three Maloney 400-kva transformers step down from 13,200 volts to 2300 volts for the 25-cycle primary motors with which the dredge is equipped.

PRACTICAL INSTALLATION OF RELAYS ON ALTERNATING-CURRENT CIRCUITS.

By C. E. Freeman.

As overload relays are used on practically all alternating-current circuits, a few suggestions as to their installation and adjustment may be of interest to a large number of electricians who have not had practical experience in adjusting relays. On account of the troubles on feeder circuits on transmission lines due to such causes as lightning, short-circuits, grounds, etc., it is necessary to install some device that will open the circuit in case of trouble and relieve the system without interfering with the supply of energy to other lines. It is usually not desirable to open a circuit for a momentary overload not severe enough to injure apparatus; but on the other hand if the trouble is serious the circuit should be opened promptly. This result is readily accomplished by the use of an overload relay with a time-limit attachment. If the circuit is not important enough to justify the additional expense entailed in the installation of a time-limit relay, a simple instantaneous relay may be used.

There are a large number of different types of relays, but only a few of the types in ordinary use will be considered; that is, open or closed-circuit relays, either of which may be instantaneous or have a time limit in its action, and types suitable for single-phase, two-phase or three-phase circuits. The relay is operated by a series transformer having its primary winding in series with one leg of the circuit to be protected. For a two-phase circuit two series transformers and two single-phase relays or a double-pole relay, the latter being two relays in one case, are required. Usually for a three-phase circuit only two transformers and two single-phase relays or one double-pole relay are necessary; but in some cases three series transformers are required to protect the circuit.

The relay is always operated by alternating current and consists of a winding with a movable core or plunger made of a bundle of fine soft-iron wire. The position of the plunger is adjustable, and when the winding is energized the plunger is sucked up and held in a central position. In Fig. 1 is shown a winding with a core free to move. When a sufficient amount of current is passed through the winding the core is pulled up into the position shown at the right; the lower the position of the core the more current is required to start it and pull it into a central position. By adjusting the position of the core it may be set to take any predetermined strength of current within the range of the coil.

OPEN-CIRCUIT RELAY.

In another type the strength of current required to raise the core is varied by adding small weights to the core, without changing its position. In either case if the core is left free to move its action will be practically instantaneous. The switch is usually opened by a trip coil, although in some cases the switch latch can be tripped by the relay core if instantaneous action is desired; but since the current in the relay increases gradually, for instance in case of an overload, the action of the core may not be quick enough to give the latch the quick blow necessary to open the switch. For that reason it is customary to use a separate trip coil to trip the switch latch. The trip coil may be operated by either alternating or direct current. Its core in being drawn up strikes a latch and releases the switch. When the core in the relay reaches its highest position it closes the trip-coil circuit and the switch is then opened. This type of instrument is known as an open-circuit relay (Fig. 3) and requires the current from the secondary of the series transformer to operate the relay and current from another source (usually alternating or direct current at 125 volts) to operate the trip coil.

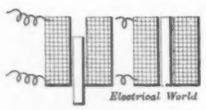


Fig. 1—Solenoid with Free Core.

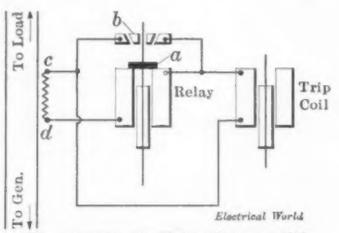


Fig. 2—Single-Pole Relay with Trip Coil (Series Type).

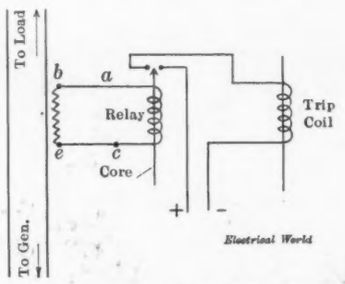


Fig. 3—Single-Pole Relay with Trip Coil (Open Circuit Type).

CLOSED-CIRCUIT RELAY.

The closed circuit or series trip type of relay is shown diagrammatically in Fig. 2. A threaded stem passes through the core of the relay, allowing the core to be adjusted on this stem, and a collar *a* pinned to the stem limits its downward movement. When the core is drawn up the collar lifts the contact block *b*, which is loose on the stem. These three contact blocks form a low-resistance shunt across the terminals of the trip coil so that any current passing through the relay from terminal *d* of the series transformer has two return paths—a low-resistance path through the contact blocks or a comparatively high-resistance path through the trip-coil winding. When the current reaches such a value that it lifts the core and by it the middle contact block the low-resistance path is opened and the current has then only one path—that through the trip coil, which then operates and opens the main switch. Usually the trip-coil core is also adjustable so as to require a certain current strength to operate it.

Unless the contact blocks are of such construction as to be easily cleaned this type of relay causes trouble on account of the corrosion of the contact blocks. As the contact is maintained by the weight of the block, and as it carries current all the time, if the circuit carries a normal load constantly, the contact surface will in time become corroded. If the relay is subject to vibration pitting of contacts results. This induces heating which may increase the resistance to such an extent that most of the current will flow through the trip coil. There is consequently danger of opening the circuit needlessly, so that in actual practice the open-circuit type is much to be preferred. However, one advantage possessed by the closed-circuit or series type is that it requires no other current than that furnished by the series transformer.

TIME CONTROL.

To control the time required to close the trip-coil circuit, an arrangement similar to a dashpot is employed. This usually takes the form of a small bellows of light leather having a small aperture to allow the air to escape slowly. One side is attached to the frame of the relay and the other to the stem which carries the core, and as the core raises the stem it expels the air. By changing the size of the aperture the air may be allowed to escape rapidly or slowly, according to whether a rapid or slow time limit is desired, and as a rule the time limit will be in inverse proportion to the current tending to operate the relay. That is, the greater the current the more rapid the action of the relay,

hence the name "inverse-time-limit" relay. In other words, if the relay be set to open on an overload in five seconds, for a heavy short-circuit it would open in one second, or less.

CIRCUIT CONNECTIONS OF RELAYS.

In Fig. 3 are shown the connections for an open-circuit relay on a single-phase circuit. It is immaterial which

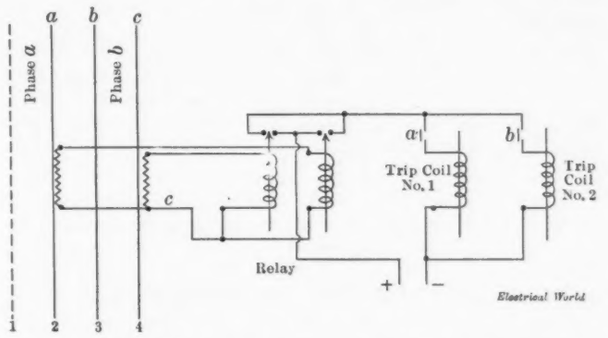


Fig. 4—Double-Pole Relay on Three-Wire or Four-Wire, Two-Phase Circuit or Three-Wire, Three-Phase Circuit.

terminal of the series transformer is connected to any particular terminal of the relay winding, as *a* or *c*. Moreover, the circuit supplying the trip coil may be either alternating or direct but must have a voltage suited to the trip-coil winding. For a two-phase circuit use may be made of a double-pole relay or two single-pole relays connected as shown in Fig. 4. Wire *c* in the latter case is the common return for both series transformers, and if the system is two-phase, three-wire, lead No. 1 would be omitted and lead No. 3 would be the common return.

Usually there are two switches for every important feeder to enable it to be connected to either one of duplicate sets of busbars. This would require two trip coils and the series transformers would be installed on the line side of the switches, so that only two series transformers are necessary, as will be readily seen by inspection of Fig. 4. The two trip-coil circuits would be connected in parallel. If it is desired that only the trip coil shall operate when the switch is closed, a small switch may be inserted in the trip-coil circuit as at *a* and *b*, Fig. 4, so that when switch No. 1 is open it automatically opens the small switch *a*. The same is true for switch No. 2, which would control the small switch *b*. The wiring diagram applies as well to a three-wire, three-phase circuit.

If properly installed on a delta-connected system, only two series transformers and a double-pole relay or two single-pole relays are necessary to protect the circuit. Suppose there are a number of local feeders fed by a set of busbars (Fig. 5). If there should be a dead ground on lead *c* of circuit No. 1 and another dead ground on lead *b* of circuit

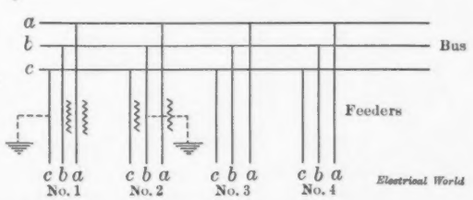


Fig. 5—Incorrect Installation of Series Transformers on Feeder.

No. 2, there would be a dead short-circuit on phase *b-c* of the busbars. If the series transformers on feeder No. 1 should be installed on leads *b* and *a*, and on leads *c* and *a* of feeder No. 2, then the path of the short-circuiting current would not include a series transformer; hence neither switch would open. The trouble would then cause the opening of a circuit-breaker, which would disconnect the busbars and interrupt all service supplied from this particular set of busbars instead of opening the particular feeders that are in trouble. But if the series transformers are installed on leads *c* and *a* of all feeders the circuits would be fully protected, for grounding two different leads of different feeders would always include at least one series transformer in the circuit.

If the voltage is not too high, a feeder may be operated with one lead grounded, but as the voltage increases it becomes more difficult to keep the circuit in service. For

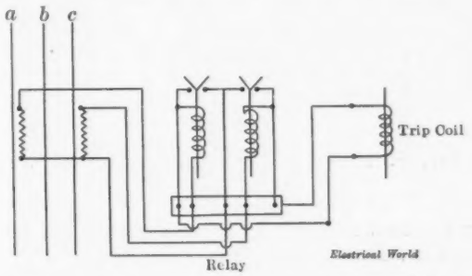


Fig. 6—Double-Pole Relay on a Three-Wire, Two-Phase or Three-Phase Circuit.

instance, if a high-tension line is in good condition and dry it would be possible to use the circuit in case of necessity with one lead grounded for voltages as high as 11,000 or over; but if the circuit is not well insulated there would be danger of a breakdown at some weak point and it might be impossible to keep the switch in on feeders of much lower potential. However, a feeder of lower potential, say 2200 or 3300, may be kept in service until repairs can be made.

A closed circuit or series-type relay is connected as shown in Fig. 6 for a three-wire, two-phase or three-phase feeder. If there are two switches, the two trip coils may be connected in series or in parallel. If it is desired to have the coils inoperative when the switch is open, the small switch controlled by the opening or closing of the main switch should be so arranged that it will close when the main switch opens. It can then be connected to short-circuit the trip coil; that is, as soon as the main switch opens it short-circuits its trip coil. As shown in Fig. 7, the auxiliary switches *a* and *b* open when the corresponding main switches are closed. Another type of relay is shown in Fig. 8. By tracing out the connections it will be found to be the same as that shown in Fig. 6 except that the latter possesses only one trip coil.

For small installations usually one set of busbars and one switch for each feeder are installed, and hence the relay need operate only one trip coil. But in larger plants the busbars are in duplicate and each feeder will have two

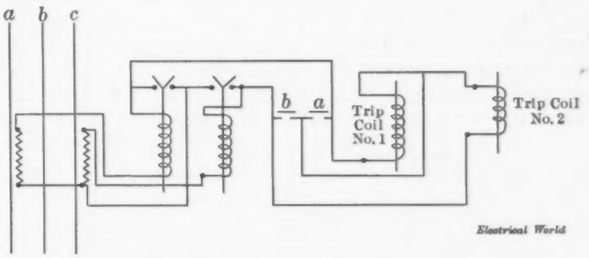


Fig. 7—Two Trip Coils for Double-Pole Relay (Series Type).

switches and require two trip coils. Sometimes the switches are made interlocking so that only one may be closed at a time. For duplicate busbars the interlocking device should be removed so that the feeder may be transferred from one bus to another without opening the circuit; that is, both switches would have to be closed when making the transfer. Of course, the busbars would have to be parallel first, and

each switch should control its own trip-coil circuit. If for any reason the switches should be operated in parallel, this method would open both switches simultaneously in case of trouble.

Trip coils operated by alternating or direct current at constant voltage must not be short-circuited, but the circuit must be opened as in Fig. 4 at *a* or *b*. Trip coils operated

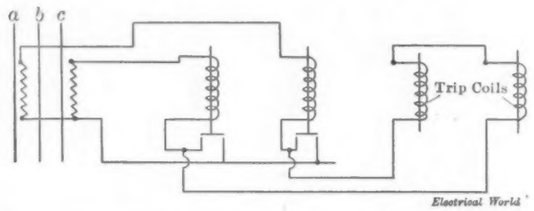


Fig. 8—Connections for Two Trip Coils for Double-Pole Relay (Series Type).

by current from a series transformer must not be open-circuited but must be short-circuited as in Fig. 1 at *a* or *b*. To open the trip-coil circuit otherwise would open the secondary of the series transformer at the very worst time; that is, when the current in the primary is at a maximum. When it is desirable to open two main switches simultaneously by trip coils operated with current from the secondary of series transformers (series type) it is better to connect the trip coils either in series or in multiple and not attempt to make them inoperative when either main switch is open; because if one is short-circuited the current in the other will be of a different value for the same overload current in the main circuit owing to the change of impedance of the secondary due to short-circuiting one coil.

The connection shown in Fig. 9 should not be used because relays so connected would not protect the circuit for a short-circuit on one phase. If leads *a* and *c* should become short-circuited it would result in their becoming for the instant a single-phase circuit, current going out on one lead and returning on the other. The current flow in the secondaries would then be in the direction shown by the arrows and would not pass through the relay winding at all. The proper connection is shown in Fig. 4.

There are, of course, many different connections that can be used in special cases, but the ones given are in general use. For instance, each relay coil could consist of two distinct coils, one in each side being connected in series, as in Fig. 10, which would result in lifting both plungers for trouble on any phase of the feeder. The trip coils can be similarly arranged, so that either plunger will operate both trip coils.

ADJUSTMENT OF RELAYS.

To adjust the relay to open for a certain overload, a temporary circuit of alternating current of low voltage should be run to the relays (125 volts or lower will do). Usually the full-load current in the secondary of the series transformers is 3 amp or 5 amp, and the relay windings should of course be suitably wound. The first step is to find

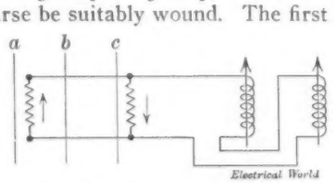


Fig. 9—Incorrect Method of Connecting Series Transformers.

the maximum current at which it is desired to open the feeder, and this, of course, depends on the load. Allowance must be made for excess current used in starting large motors, etc. The importance of the feeder circuit should also be considered, as it may carry a load that it is necessary to keep in constant service. If the feeder is fully loaded it will be necessary to set the relay higher than would be the case where the usual load is much below the current-carrying capacity of the feeder. For instance, if the feeder is 75 per cent loaded the relay could be set to trip at, say, 100 per cent or 150 per cent above full load. With a time limit of three or four seconds this would give the fuses on a service a chance to blow, thus confining the trouble to one consumer and not interfering with other

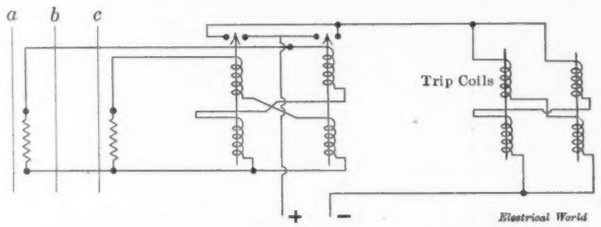


Fig. 10—Connections for Simultaneous Action of Relays and Trip Coils.

service. If the load is light, 100 per cent more than the actual load could be the limit used. Instantaneous relays could also be set at somewhat higher value than the time-limit type.

To measure the current applied to the relay a low reading ammeter (15 amp or 20 amp) will be very convenient, or in case there is none to be had a bank of ordinary 16-cp lamps taking about ½ amp each and connected in multiple could be employed. However, an ammeter gives more accurate results.

A simple rheostat for use in connection with an ammeter consists of an ordinary galvanized iron bucket, partly filled with water in which a small quantity of salt has been dissolved, connected as shown in Fig. 11. One side of the circuit is connected to the bucket and the other side to one terminal of the ammeter. The other ammeter terminal is fastened to one side of the relay winding. A strip of copper or any other metal is fastened to a piece of board, so that it will not come in contact with the bucket when it is lowered in the water, and a wire connected to this strip is attached to the other terminal of the relay. A single-pole switch is then connected so as to short-circuit the relay winding.

Assume that the instrument to be set is a double-pole time-limit relay on a three-wire, three-phase feeder capable of carrying 300 amp per lead; that the maximum load is 200 amp, and that it is desired to have the switch open on

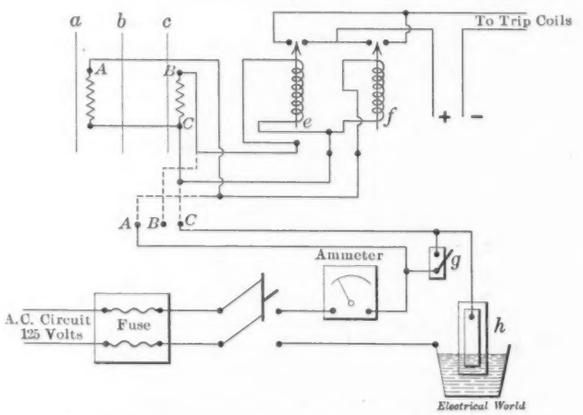


Fig. 11—Test Connections for Relay Adjustment.

an overload of 100 per cent in four seconds. The relay should then operate at 400 amp. Suppose the series transformer ratio to be 60 to 1. The full-load current in the secondary would be $300 \div 60 = 5$ amp, and when there is 400 amp in the primary the secondary current would be $400 \div 60 = 6\frac{2}{3}$ amp.

The adjustment can be made more conveniently when

the feeder is ready for service but before any load is put on it. The leads to the relay should be disconnected at the series transformers and the main switch closed, connections being made as in Fig. 11 for testing side *f* of the relay. As the load builds up in the water rheostat circuit, the short-circuiting switch *g* should be closed and the load *h* gradually lowered into the water until the ammeter indicates 6⅔ amp. The board may be suspended in this position and the switch *g* suddenly opened. The current will then flow through the relay winding, and it will be found that if the ammeter reads exactly 6⅔ amp before switch *g* is opened the current will decrease slightly after this switch is opened, owing to the extra resistance of the relay winding. The board must be lowered in the bucket slightly and the current flow increased so that when the switch *g* is opened the ammeter will indicate 6⅔ amp. In the case of an instantaneous relay, opening the switch *g* would cause the core to rise promptly, close the trip coil circuit and trip out the main switch. The operator should lower or weight the core so that it will not lift, then adjust it gradually until it lifts promptly and trips the main switch. The core may be locked in this position.

A time-limit relay requires different adjustments. A stop watch is very convenient for setting this type of relay, the watch being started as the switch *g* is opened and stopped as the main switch trips out. The core in this case is adjusted to rise slowly when 6⅔ amp is passed through the relay winding. Then the adjustment is changed on the aperture of the bellows, so as to bring the time required for the core to rise nearer to the time desired. Further adjustment of the position of the core may have to be made when the adjustment at the bellows is changed until

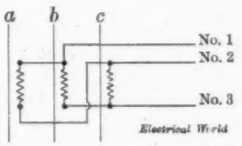


Fig. 12—Z-Connection for Three-Phase Grounded Neutral or Four-Wire Circuit.

the time and current values are correct. The other side of the relay may then be adjusted in a similar manner.

To regulate the series or closed-circuit type of relay the same rheostat may be used and the adjustment made in a similar manner, except that the trip-coil core must come up with sufficient force to trip the latch on the main switch. If the feeder is in service, it is inconvenient to adjust the relays without interrupting the service; but arrangements can be made to make the adjustments on a Sunday or holiday when there is no load on the feeder. When this is impossible and it is not desirable to interrupt the service the main switch should be blocked in such a way that the usual strain will be on the latch; that is, the switch should not be held in tight, but held in by the latch in such a way that when the latch is tripped the switch will just start to open. This method will leave the usual strain on the latch, so that the trip-coil core can be adjusted to strike the latch hard enough to trip the switch.

Before disconnecting the leads from the secondary side of the series transformer they must be short-circuited if there is any load on the feeder. When the relay adjustments need only be approximate, or in case a low reading ammeter cannot be obtained, a bank of lamps may be used in place of the water rheostat. The lamps should be connected so as to get the proper current. For circuits with grounded neutral, such as a three-wire Y-connected system or a four-wire, three-phase system, three series transformers are required, one in each main lead. The instrument may be double pole or comprise two single-pole relays, but the transformers must be connected as shown in Fig. 12, lead No. 2 being used as the common return.

THE USE OF DEPRECIATION DATA IN RATE-MAKING AND APPRAISAL PROBLEMS.

By Halbert P. Gillette.

A GREAT deal recently has been written on the subject of depreciation, particularly with reference to the use of depreciation rates in calculating the depreciated values of public utilities, but very little on the use of depreciation data in rate-making problems. The latter use is of far more importance to public service companies than the former wherever the rates of such companies are the subject of action by rate-making commissions or courts. In the following discussion of the subject the writer has attempted to distinguish between "actual accrued depreciation" and "estimated prospective depreciation." The writer has also indicated what he believes to be correct methods of analyzing annual maintenance expenses into "repairs" and "renewals." The importance of so doing has apparently not been recognized by many public service companies or by many public service commissions. Yet this is often a vital matter.

Because of its simplicity the straight-line depreciation formula has been most commonly used by appraisers, but it frequently gives results that are believed to be demonstrably erroneous, as will be shown. The advocates of the sinking-fund depreciation formula have persisted in using fallacious arguments in support of its supposed general applicability, yet the formula is properly applicable in many cases, although it fails in certain cases because it lacks generality. It is, indeed, only a special case of a general formula that the writer calls the "unit-cost depreciation formula."

Many appraisers have failed to recognize the fundamental difference between "natural depreciation" and "functional depreciation," in consequence of which an accrued "functional depreciation" has often been assigned to plant units where none existed at all. Because of common errors and because his assistants needed written guidance at times, the writer has taken the trouble to prepare discussions of depreciation and maintenance problems at some length. These discussions have been used by the writer as a part of his various appraisal and rate-making reports on properties managed by Stone & Webster, and extracts from them may prove of assistance to others who are interested in appraisals and in rate-making problems.

DEPRECIATION.

Depreciation may be defined as the loss of value resulting from loss of useful life of a plant unit, or from a drop in unit prices. Here the term plant unit implies any unit to which a unit cost is assigned. Since the cost of a machine may be split up into many units to each of which a unit cost may be assigned, it follows that appraisers may differ greatly as to what they call a plant unit. The author prefers to call a whole machine—such as a generator—a plant unit, and to treat the depreciation of the machine as a whole. The cost of replacing parts of the machine the writer prefers to classify under the term repairs, which will be discussed later.

Natural depreciation is loss of value due to physical or chemical changes in plant units. Decay, rust, electrolysis, wear and tear are common causes of natural depreciation. Past natural depreciation can be calculated either by inspecting the plant units or by the use of plant mortality tables which are applied to the known ages of the plant units. The weighted age of each class of plant units should be calculated as described later.

Functional depreciation is loss of value due to (a) obsolescence or (b) inadequacy. Obsolescence arises wholly from "improvements in the art"—inventions. Inadequacy arises from increased demands upon plant units rendering them economically too small or too light for the increased service required.

Estimating Depreciation Due to Obsolescence.—If a new invention has resulted in the production of a machine that will perform a given service at a less cost than an existing old machine, the obsolescence depreciation of the old machine is calculated thus: From the total capitalized cost of production with the old machine deduct the total capitalized cost of production with the new machine, and the remaining sum is the obsolescence depreciation of the old machine.

For example, assume that the first cost of the old machine is $35,000 and that its annual operating expense (including natural depreciation and taxes) is $6,000. Then, if the interest rate is 6 per cent, we have:

Old machine:

First cost	$35,000
Capitalized operating expense, $6,000 ÷ 0.06	100,000
Total capitalized cost	$135,000

If an improved new machine has a first cost of $45,000 for the same output as the old machine and an annual operating expense (including natural depreciation and taxes) of $4,200, we have:

New machine:

First cost	$45,000
Capitalized operating expense, $4,200 ÷ 0.06	70,000
Total capitalized cost	$115,000

The obsolescence depreciation of the old machine is, therefore, $135,000 minus $115,000, or $20,000. Hence the depreciation value of the old machine is $35,000 minus $20,000, or $15,000.

Occasionally a calculation of this sort will disclose the fact that an old machine is not only valueless but worse than valueless, or has a minus value because it is so hopelessly out of date. It cannot be appraised at a minus value, however, for it can be replaced by a new machine and thus wipe out the annual loss from its use. Moreover, it may have some scrap value.

Estimating Depreciation Due to Inadequacy.—If a machine has become too small to perform its function economically, its depreciation due to inadequacy may be calculated in the manner just outlined for calculating depreciation due to obsolescence. Since inadequacy usually implies that more than one old machine is needed to perform the work of a new (adequate) machine, it is preferable to solve the problem of depreciation thus:

Ascertain the total cost per unit of product (or service) that the old machine yields, and deduct therefrom the corresponding total unit cost of product that the new machine yields. Multiply this saving in unit cost by the number of units annually produced by the old machine and capitalize this total annual saving by dividing by the interest percentage. The quotient is the inadequacy depreciation of the old machine.

Accident depreciation is the loss of plant value due to accidents. Destruction of property by flood, fire, tornado and earthquake comes under this head. So also does property loss due to failure of structures through errors or carelessness in design or operation. Accident depreciation should be provided for in one of three ways or by a combination thereof: (1) insurance, (2) accident reserve or surplus, or (3) increase in the rate of "fair return" on the investment.

Demand Depreciation.—If a plant is provided to serve a mine or mining community, the demand for its service may decrease gradually or may suddenly cease entirely. So, too, may the demand for a railway serving a timbered district fall off or cease. Demand depreciation, then, is loss of plant value due to decrease in demand for the use of the plant. It should be provided for, wherever it is likely to occur, by (1) an amortization fund, (2) accumulation of a surplus, or (3) an increase in "fair return."

Price depreciation is loss of value resulting from a drop in unit prices. It often happens that unit prices during the actual construction of a plant were higher than they are at the time of a subsequent appraisal. This may be due to several causes, such as (1) a period of relative financial depression at the time of the appraisal; (2) improvements in the art of manufacture, transportation or distribution that lower unit costs; (3) the fact that piecemeal construction prices exceed the unit prices used by an appraiser who estimates costs on a basis of wholesale prices. Whatever the cause of this unit price depreciation, the appraiser should allow for it in calculating development cost, for it is a deficit incurred in the development of the business of the utility company and one that cannot be controlled by the company.

Of course, if the appraiser uses the historical method of appraisal there will ordinarily be much less price depreciation than if the appraiser uses the replacement method. If price depreciation is not provided for in the development cost, it should have consideration by allowing a higher rate of fair return on the investment than would otherwise be permitted.

Two Distinct Uses of Depreciation Data.—Actual accrued depreciation must be deducted from cost new to get depreciated value. This is the only use to which depreciation data should be put in an appraisal. But in a rate-making problem the factor of probable future depreciation enters, and then both the probable functional depreciation and probable natural depreciation must be considered. Depreciation, for appraisal purposes, is related to the past and to what is actual. Depreciation for rate-making purposes relates to the future and to what is probable. This distinction is vital.

Resultant Depreciation.—In calculating the probable future annual depreciation of a plant it is necessary to consider both the natural depreciation and the functional depreciation, to ascertain the resultant annual depreciation. If any class of plant units, like engines, suffers more rapid functional depreciation than natural depreciation, then the natural depreciation can be ignored, for the engines will be renewed because of functional depreciation at an earlier date than would be the case if only natural depreciation were acting. On the other hand, if natural depreciation is greater than functional depreciation, as usually is the case with the wooden poles of a transmission line, then functional depreciation must be ignored.

The sum of all the resultant annual depreciations of the different classes of plant units gives the total resultant annual depreciation of the plant, and it is this total which must be provided for in one or more of the following ways: (1) current renewals charged to maintenance, (2) depreciation fund or renewal reserve, (3) surplus, (4) high enough "fair return" distributed to the owners of the plant to recoup them for probable depreciation.

Bond Sinking Fund Not to Be Confused with Depreciation Fund.—A bond sinking fund is merely a sum of money accumulated to pay off a debt. If it happens that the debt matures at the same time that the plant reaches the end of its useful life, the bond sinking fund may be a true depreciation fund, provided the par value of the bonds equals the full value of the plant. This, however, is seldom the case. There is, therefore, no necessary relation between a bond sinking fund and a depreciation fund. However, it is clear that a public service company should not be permitted to deduct both the annuity for a bond sinking fund and the annuity for a depreciation fund from its earnings in calculating the net earnings which are to be its "fair return," for such a procedure would result in a duplication of the amortization of plant values.

WEIGHTED AVERAGE AGE OF PLANT UNITS.

The average age of any group of plant units of equal value is calculated thus: Multiply the total number of plant units of the same age by the number of years that

they have been in use; add together all such products for the given class of units, and divide the sum by the total number of plant units. The quotient is the average age of the given class of plant units.

If the plant units of a given class vary in first cost, then the weighted average age is found thus: Multiply the money expended each year in the construction of the plant units now in existence by the age in years; add these products together, and divide by the total cost. The quotient is the weighted average age of the given class of plant units.

In applying this last rule care must be taken to make adjustments needed to provide for fluctuations in unit prices, so that standard unit prices may be applied to all. Care must also be taken to ascertain whether any plant units as originally built have been renewed; and to this end both the original construction accounts and the maintenance and renewal reserve accounts should be investigated.

WEARING VALUE.

The wearing value of a plant unit is the difference between its cost new and its scrap value. To the great majority of plant units it is practically useless to assign any scrap value, for the scrap value is usually so insignificant a part of the cost new that it gives an appearance of great accuracy to the depreciation calculations where no great accuracy can exist in most cases. When the life of most plant units is itself a matter of rough approximation, no greater accuracy is attained by assigning any scrap value to most classes of plant units. Copper wire is the only class of plant unit to which the writer has assigned a scrap value in many of his appraisals. Depreciation percentages may be expressed either in terms of the cost new or of the wearing value.

ANALYSIS OF MAINTENANCE ACCOUNTS AND UPKEEP COSTS.

Before the true net earnings of a plant can be accurately ascertained it is necessary to analyze the maintenance accounts, for it will usually be found that the actual expenditures for upkeep in any given year are less than the average expenditures for upkeep will be in the years to come. Simply because a plant is old it must not be assumed that its upkeep expenditures have reached a normal or average condition. Yet this assumption has often been made.

Upkeep cost is the actual expenditure for current repairs and current renewals (maintenance) plus the annual depreciation not provided for in the actual expenditure in renewals.

Current maintenance, or maintenance as the term is commonly used by accountants, is the actual expenditure for current repairs and current renewals.

Repairs is the term applied to the current expenditures for keeping the parts of plant units in serviceable condition.

Renewals, as used in this connection, are the current expenditures for the renewal of whole plant units.

Annual depreciation, as used here, is the estimated annual loss of value from all causes, including natural and functional. Annual depreciation usually exceeds annual renewals in plants that are not very old. Hence the extreme importance of not assuming that annual renewals are probably sufficient to cover annual depreciation. Annual renewals are usually only a part of annual depreciation, and annual depreciation is, in turn, only a part of annual upkeep cost, for annual depreciation does not include annual repairs. Great confusion still exists in the minds of many people as to these terms, partly because they are not used in the same sense by all engineers. Serious errors have occurred, both on the part of public service companies and public service commissions, in estimating the probable annual upkeep cost. Sometimes in such estimates annual repairs have been omitted, but more often the error has arisen because actual annual renewals of the previous year were assumed to cover all probable annual depreciation.

METHOD OF ESTIMATING ANNUAL UPKEEP COST.

As at present conducted, no public utility company keeps its accounts in such a manner as to segregate maintenance expenses into repairs and renewals, using these terms as above defined. Yet, if we are to make proper estimates for depreciation funds, or if we are to ascertain the true operating expense, it becomes essential to separate maintenance into repairs and renewals.

If the weighted age of any given set of plant units is less than half the total life of units of that class, the expenditures for renewals of the plant units are below what they must ultimately be. Thus, if the life of railway cross-ties is ten years and if the weighted age of a given lot of ties is three years, it is evident that tie renewals are still below normal. When, however, the weighted age becomes five years (that is, half the life) it is evident that tie renewals have reached a normal stage, for there will then be ties of all gradations of age, from those just put in the track to those just ready to be taken out.

When the weighted age of most classes of plant units has not yet reached half the total life, it becomes exceedingly important to analyze the maintenance accounts. Otherwise, if the present maintenance expenditures were regarded as being normal, no adequate allowance would be made for depreciation that is now going on but is not yet being paid for.

In the same manner current repairs increase with increasing age of the plant units. Hence neither repairs nor renewals can be properly judged until an analysis is made of the maintenance accounts and until the weighted age of each class of plant units is determined.

Maintenance, as before stated, is the cost of repairs plus the cost of renewals of such plant units as have been charged to the operating account. When a plant is young repairs are usually inexpensive and there may be few or no renewals of plant units at all. Hence, unless a renewal reserve account is provided, there may be little or no charge for annual plant depreciation shown on the books, although depreciation is actually occurring. When a large plant becomes old there are heavy repair expenses which are quite uniform, but the actual renewals of many classes of plant units fluctuate from year to year. In other words, the annual expenditures to replace plant units—the year's depreciation—are apt to fluctuate, and the fewer the number of plant units the greater the fluctuation.

Having analyzed the annual maintenance expenses of a plant so as to show what has been expended for renewals and what for repairs, the next step is to compare the actual expenditure for renewals with the estimated annual depreciation. In the case of most plants it almost invariably happens that the actual renewal expenditures fall below the estimated annual depreciation.

The true total upkeep expense is the sum of two items, (1) repairs and (2) depreciation; while the actual maintenance expense is the sum of two items, (1) repairs and (2) renewals. Since depreciation usually exceeds renewals, and always exceeds it in the case of a new plant, it is of the utmost importance that the excess be accurately ascertained before passing upon the question of rates charged for service.

Suppose, for example, that the estimated depreciation of cross-ties is 8 per cent per annum, and that the total cost of the ties is $20,000; then the annual depreciation is $1,600. If the actual tie renewals for a given year show a cost of $600, it is evident that tie renewal costs for that year are $1,000 below normal.

Where the number of plant units of any given class is large, and where they are of varying ages, a normal condition of renewals is not reached until the weighted age of all plant units of that class is half the total life of a plant unit of that class. Keeping this fact in mind, it is possible to tell roughly whether or not the renewals of a given class of plant units have been normal during a given year,

provided only that we know the weighted age of the plant units. But the more precise method to use is the one above outlined, which may be summed up thus:

Segregate the actual annual maintenance expenses into repairs and renewals. Deduct all the renewals and add the estimated annual depreciation. The resulting sum will be the total true annual upkeep cost.

When nothing but the ordinary accounting records are available the segregating of renewals from repairs often seems like an impossible task in the case of certain classes of expense items, but usually a way can be found that will enable a sufficiently close approximation to be made. A study of the "stock slips," for example, will disclose the purposes for which given amounts of materials were used. Having ascertained the amount of materials used for renewals, the labor required to put the given material in place may be estimated. Some maintenance accounts, like those for ties and rails, contain only the cost of materials used for renewals. In such cases, also, the labor of placing these materials in the plant can be estimated and then added to the cost of the materials. The "requisitions" also show all the purchases of equipment, and a study of the equipment and accounting records discloses whether a given purchase was for renewals or for extensions to plant.

DEPRECIATION FORMULAS.

There are three formulas by which accrued depreciation has been calculated by appraisers: (1) straight-line formula, (2) sinking-fund formula, and (3) unit-cost depreciation formula. In addition to these, what may be termed a "progressive diminution formula" is sometimes used. It involves reducing the value of a plant each year by subtracting from its last year's value a percentage thereof. This method is rarely used in appraisals.

Straight-Line Formula.—According to what is called the straight-line formula, accrued depreciation is calculated thus: Multiply the age in years of a given plant unit by the percentage of life that it loses annually, and the product is the accrued depreciation. Thus, if poles have a life of twenty years, the annual loss of life is 5 per cent; hence a pole eight years old has depreciated 8×5 per cent = 40 per cent, and its "present value" is 60 per cent, according to the straight-line formula. This formula is the simplest of all and has been most used in appraisals.

Sinking-Fund Formula.—According to the sinking-fund method of calculating depreciation, it is assumed that the accrued depreciation of a plant unit is the amount already accumulated in a sinking fund that was begun when the plant unit was first put into service and whose annuities are such that, at compound interest, the amount at the end of the life of the plant unit will equal the first cost of the unit.

The argument upon which the sinking-fund depreciation formula was originally advocated is this: The purchaser of a depreciated plant should be willing to take the plant at its first cost, provided he also were to receive an accumulated sinking fund that would eventually (at the end of the life of the plant) equal the first cost of the plant. Hence, if the purchaser takes only the depreciated plant, he should take it at its cost new less the accumulated sinking fund. This argument appears to be sound, provided the plant unit is of a kind whose operating expenses, current repairs and service performed remain constant throughout the life of the plant unit. But the argument is unsound when operating expense and repairs increase, or when the service or output decreases, as the plant unit grows older. In brief, the sinking-fund depreciation formula applies only to special cases, although they occur with some frequency. The author regards the next method as the economically exact and most general one.

Unit-Cost Depreciation Formula.—This depreciation formula is predicated upon the broad economic principle that decrease in economic value of plant unit is determined by the increased unit cost of its product or service. This increased unit cost of the product or service is, of course, relative, and if the standard of comparison is an improved or larger machine, then we deduce the economic depreciation as already described under the headings relating to calculation of obsolescence and inadequacy depreciation. But increased unit cost of production may occur not only because an old machine requires greater repairs than a new one but because it annually turns out fewer units of product, owing to being shut down more often for repairs. It is this loss of economy in production with an old machine as contrasted with a new machine that often causes depreciation in addition to that calculated by the sinking-fund formula. To calculate true economic depreciation due to the aging of a machine we must have a more general formula than the sinking-fund depreciation formula. The unit-cost depreciation formula is predicated upon the following principle of equity: The purchaser of a second-hand machine is entitled to purchase it at such a price that during its remaining life he may produce each unit of service or output at the same average unit cost as would be entailed during the entire life of the machine. For the term "machine" may be substituted "plant unit" or "structure." This fundamental proposition, in the writer's opinion, needs no argument in its support. The equitable second-hand price to be determined by this criterion is the true depreciated value.

Let

C = first cost of new plant unit.
c = depreciated value of old plant unit.
F = sinking-fund annuity to amortize C in its life of N years.
f = sinking-fund annuity to amortize c in its remaining life of n years.
N = number of years of life of new plant unit.
n = number of years of remaining life of old plant unit.
Q = average annual operating expense, exclusive of repairs, but including taxes, during N years.
q = average annual operating expense, exclusive of repairs, but including taxes, during remaining n years.
P = annuity to provide for repairs to parts of the new plan unit during its life of N years.
p = annuity to provide for repairs to parts of the old plant unit during n years.
r = rate of interest, expressed as a decimal.
U = average unit cost of the product or service of the new plant unit during N years.
u = average unit cost of the product or service of the old plant unit during its remaining life of n years.
Y = average annual number of units of product during entire life of N years.
y = average annual number of units of product during remaining life of n years.

Then

$$U = \frac{Q + P + F + rC}{Y} \qquad (1)$$

$$u = \frac{q + p + f + rc}{y} \qquad (2)$$

But, to secure the same economy of production during the remaining life as during the entire life, U must equal u. Hence

$$\frac{Q + P + F + rC}{Y} = \frac{q + p + f + rc}{y} \qquad (3)$$

The sinking fund annuity which will accumulate to $1 in N years is given by the formula:

$$D = \frac{r}{(1 + r)^N - 1} \qquad (4)$$

Likewise for n years we have

$$d = \frac{r}{(1 + r)^n - 1} \qquad (5)$$

The annuity for the redemption of C dollars is

$$F = DC = \frac{rC}{(1+r)^N - 1} \qquad (6)$$

The annuity for the redemption of c dollars is

$$f = dc = \frac{rc}{(1+r)^n - 1} \qquad (7)$$

Substituting these values of F and f in equation (3) we have

$$\frac{Q+P+DC+rC}{Y} = \frac{q+p+dc+rc}{y} \qquad (8)$$

Solving (8) for c we have

$$c = \frac{y}{d+r}\left(\frac{Q+P+DC+rC}{Y} - \frac{q+p}{y}\right) \qquad (9)$$

Equation (9) is the general form of the unit-cost depreciation formula. The values of D and d may be calculated by equations (4) and (5), or they may be obtained from sinking-fund tables.

It frequently happens that $Y = y$, as in the case of fixed plant units, like buildings, railway ties, etc., that perform an unvarying service throughout their life. Then if $Y = y$, equation (9) becomes

$$c = \frac{(Q+P-q-p) + (D+r)\,C}{d+r} \qquad (10)$$

In the case of many sorts of plant units, particularly fixed structures, $(Q+P-q-p)$ is zero or infinitesimal; then (10) becomes

$$c = \frac{(D+r)\,C}{d+r} \qquad (11)$$

or

$$\frac{c}{C} = \frac{D+r}{d+r} \qquad (12)$$

Equation (12) gives identically the same results as the sinking-fund depreciation formula, and it may be easily proved to be only a different form of that formula as it is usually given. In the usual form of the sinking-fund formula d is calculated by equation (5), in which n is the total life of the plant unit, whereas in equation (12) d is calculated by equation (5), in which n is the remaining life of the plant unit.

Summing up, it appears that the unit-cost depreciation formula (equation 9) is the correct general formula for ascertaining the economic depreciation due merely to age. We also see that in the case of practically all plant units that are fixed structures equation (9) reduces to the simple form of equation (12) and that this is only another form of the well-known sinking-fund depreciation formula.

DISTRIBUTION OF CONSERVED RESOURCES THROUGH EXISTING PUBLIC-UTILITY ENTERPRISES.

So much attention has been riveted on the general question of the conservation of natural resources that the problem of the utilization of the resources thus conserved has received little consideration. On the assumption that each citizen shall to the largest possible degree share the benefits of conservation, Mr. J. C. Parker, of the Rochester Railway & Light Company, proposed a plan calculated to secure this result before a recent meeting of the New York State Waterways Association at Watertown, N. Y. He contends at the outset that no true conservation is possible if hydraulic developments are taxed to such an extent as to prevent them from becoming commercially feasible in competition with the more flexible and untaxed coal power developments. The very essence of conservation will be satisfied, he maintains, if there is at hand a thoroughly organized agency for "passing conservation around." This, he said, already exists in the highly developed public-service enterprises which now cover every city, town and village of appreciable size in the country. The burden of his speech was to show that the results of conservation may be disposed of through such enterprises with advantage to the people at large, and that therefore it is the part of sanity to use them, rather than to resort to a more expensive process of duplication of effort in an endeavor to secure another, and presumably less well-organized, agency for the distribution of the benefits. Mr. Parker showed that there is practically no interest in the community which the public-service enterprise does not or cannot serve, and that this service is rendered in many states subject to a very close control by the ultimate beneficiaries, through public-service commissions.

The two elements which most perfectly serve to make these central-station enterprises efficient and equitable agents for the distribution of the benefits of conservation to all the people alike are, first, enlightened selfishness, and, second, control by commissions intrusted with broad powers. Public-service corporations have come to learn, through their own broadened experience and through the development of public sentiment, that they have a trust imposed upon them by the people who have given them franchises, and that only by the most faithful execution of this trust can they best serve the other group to which they owe an obligation—their stockholders. Self-interest dictates that absolute fairness and absence of discrimination shall govern the rendering of the most approved type of service at the lowest price consistent with a fair return to the large number of people who have undertaken, as stockholders, the expense of developing these agencies for the distribution of comfort and economic benefits. The central-station service to be maintained must be pre-eminently good and the margin of competitive difference must be increased, since a few per cent increase makes possible a vast increase in the volume of business done with the same overhead expense, and therefore results in benefits to the customer and to the stockholder alike. To this enlightened selfishness must be added the work of the public-service commissions, which guard against the exploitation of the public by service corporations in any possible manner.

Contrasting the benefits of distributing conserved resources through existing public utilities, Mr. Parker noted large economic advantages as against any other form of distribution. The foremost of these has to do with the diversity factor, so that, in addition to the conservation of the original power, the public-service utility possesses a conservation of utilization. In other words, the central station can multiply the effective capacity of the hydroelectric system above its theoretical maximum by the amount of this diversity factor. In the opinion of the speaker, it cannot be thought that in any sense conservation ceases with the production of the maximum energy output from a given watershed. Conservation, broadly understood, must mean the maximum of utility and the maximum of useful service with satisfaction from a given natural resource. If a central station can increase the output from 5000 hp with an uncorrelated and unconserved group of natural resources to 7500 hp with adequate storage and other works, it has truly made a 50 per cent increase in the usefulness of that particular natural resource, but if, in addition, it has a diversity factor of three, this 7500 hp will serve 22,500 hp of maximum demand, so that in this one factor it has further conserved the already augmented water-power at least twofold and has multiplied the initial power by four and one-half.

If, moreover, the waste of energy in industries can be eliminated a still further conservation results. Many large plants with mechanical distribution show energy losses running from 50 to 80 per cent which might be reduced to 10 or 20 per cent by proper engineering in conjunction with electrical distribution. Public-service corporations have also recently introduced new illuminants which have served

to cut down the energy consumption of lamps by nearly 70 per cent, and by the proper adaptation of illuminating engineering principles have made still further and marked economies in the utilization of energy in that period of the day when it is the greatest, namely, the peak hour. Assuming that adequate utilization will cut out a waste of at least one-half the energy in those communities where work has not as yet been prosecuted, the 22,500 "diversity" hp can be made to do the work now being done by 45,000 "uneconomic" hp, and there is no method of weighing the economic benefits handed around through energy stored in the finished product.

Public-service corporations to-day are very efficient agencies for promoting the economic utilization of the benefits of conserved water-powers, since in the efforts to secure business and make their service of the greatest advantage to their consumers many of them maintain departments of engineers to study how the power requirements in the industries served may be reduced to a minimum. These economies of utilization which are possible in a scheme of public-service distribution are often economically impossible with the local utilization of a water-power by a single industry. If the latter is not utilizing all the power available, there is no motive for economy until the time when uneconomic use means deficiency in production. If, on the other hand, the industry requires more power than that naturally available, a steam reserve has to be carried and the economic advantages of more efficient utilization are quite remote.

Though foreign to the economy of utilization, Mr. Parker pointed out two economies of operation possible to public-service corporations but seldom possible under any other scheme of utilization of conserved water-powers. These have reference to the necessity for carrying a certain amount of steam capacity or pondage in connection with hydraulic developments, and to the necessity for carrying spare units to replace any regular working units that may be out of commission at any time for repairs, etc. Regarding the first, the public-utility company is enabled to utilize the conserved water-powers much more flexibly than can any individual industry which might rent or purchase them. It is in a position to use water-power transmitted from a distance and carry a steady twenty-four-hour load, for which hydraulic generation particularly well adapts itself, and at the same time to carry a short peak load by steam generation. Mr. Parker also showed that a central station could more easily withdraw units from service and substitute therefor spare units than a small plant where it is economically impossible to subdivide the development into more than two or three units without making unjustifiable sacrifices in first cost and efficiency.

It may be remarked, said the speaker, that these economic advantages in distribution of conserved resources through public-utility enterprises are merely the result of the magnitude of the nature of the business, and the question might naturally arise as to why the state, if it takes any part in the development of these resources, should not go the whole way and distribute them, rather than use the present half public and half private enterprise for this purpose. It is the speaker's opinion that the legitimate function of the government is to enter into those enterprises which require the power of the state for their consummation, among these being enterprises of such magnitude that private capital cannot undertake them, such as a canal; those which are necessary to public health and well being, such as schools and sanitary systems, and those which require the use of the right of eminent domain. To duplicate an already existing enterprise would be the reverse of conservation, and there are grave reasons why this should not be done. The whole prosperity of modern civilization has been built up on the inducement to private enterprise offered by the hope of honest gain. Under a system of state management the element of initiative would be withdrawn from the performance of most of the men engaged in the prosecution of such an enterprise. It requires many years to build up a staff for the operation of such a work and to develop a wise, far-reaching policy of management and technique, while under a system of public control rotation in office would involve changes in personnel long before the consummation of plans made at the beginning of an administration. It cannot be thought that any governmental bureau would place so aggressively before the people the facilities of the service as do the present public-utility enterprises. Moreover, in the making of plans, receiving of bids, construction, inspection, etc., rigid inflexibility is demanded by the government as insurance against favoritism or corruption, while in a private enterprise a large amount of individual discrimination may be left with every man in the concern. For the former condition the people pay heavily, since the growth in experience and special knowledge as the work progresses cannot often be made available on the work at any time in hand, and since in the relations between the engineer and the contractor expedients which may simplify, improve or cheapen the work cannot readily be made available.

Mr. Parker believes that in this great work the law-making bodies will recognize the wisdom of utilizing the agency already at hand, and that they will recognize that any disposition of conserved resources must not be merely to get temporary protection by the people of the state, but that it should be such a transaction as will in the long run give the greatest value to the greatest number of people from the fundamental wealth with which the country has been endowed.

STORAGE-BATTERY REGULATION OF LOW-HEAD WATER-POWER PLANT.

A storage battery is used to regulate pressure variations and aid in the peak output in the interconnected 600-volt direct-current and 2300-volt and 440-volt alternating-current systems of the water-power plant supplying central-station, street-railway and flouring-mill loads at Lawrence, Kan. The low head here developed, 12 ft., makes for extremely heavy hydraulic equipment with consequent sluggish speed control. With sudden load changes the battery therefore becomes useful in instantly adjusting and

Fig. 1—12-ft. Water-Power Plant, Lawrence, Kan.

absorbing the load impulses, giving the waterwheel governors time to adjust their gate openings to meet the new load conditions. While the battery floats on the railway 600-volt system, its regulation effect is applied, through the transforming apparatus, to the 2300-volt and 440-volt alternating-current systems as well. For standby operation in the event of machine breakdown the battery energy is also

available for any of the three systems, although principally useful for the central-station lighting lines.

In the sketch are shown the 2300-volt and 440-volt buses, interconnected by 500 kw in tie transformers. A 400-kw, 2300-volt General Electric alternator, driven by Leffel wheels with a Lombard oil governor, feeds directly into the 2300-volt bus from which are led off the central-station

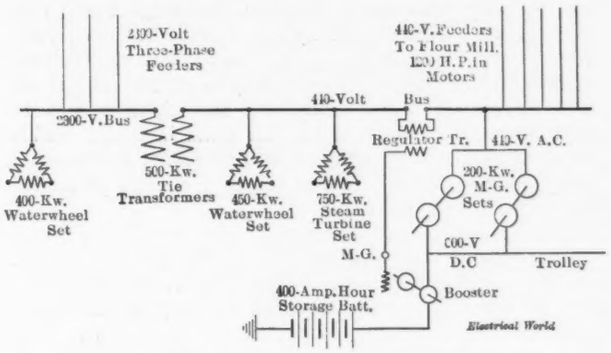


Fig. 2—Diagram of Connections.

feeders. A 450-kw, 440-volt Bullock alternator, rope-driven by Leffel wheels equipped with a Woodward mechanical governor, supplies directly the mill bus, which is also arranged for connection to the 750-kw, 440-volt General Electric turbine-alternator that has been installed as a steam reserve in case of high or low water. This 440-volt, 60-cycle bus is linked to the 600-volt trolley system by a pair of 200-kw synchronous motor-generator sets. The 400-amp-hour, 600-volt storage battery on the trolley system is controlled by an Electric Storage Battery Company's carbon-pile regulator, which acts on the booster set through field control of a small high-speed motor-generator unit. Its regulative transformer is cut in series with the 440-volt bus at a point such as to protect the lighting system from heavy demands on the trolley or mill lines. As the motors on the central-station lines are small, little protection of the kind is needed there besides the Tirrill regulation of the generators. The mill 440-volt system comprises, however, about 1200 hp in motors, several of them 200-hp units which can cause considerable shock on starting. Reproduced herewith is a recording voltmeter curve, showing the pressure regulation obtained with the aid of the battery.

In the case of shut-down of the generator units the battery can carry the lighting load for twenty minutes, the mill motors and railway system being meanwhile pulled off to conserve the cell charge. At all times when it is likely to be needed the turbine is kept warmed up and held ready to start in a few minutes. Alongside the generator room are four 150-hp boilers, equipped to burn coal, oil or natural gas. There is also large storage capacity for oil and coal.

The Bowersock Mill & Power Company owns this interesting power plant and sells energy to the Lawrence Railway & Light Company by meter on its 2300-volt and 600-volt lines. The Bowersock company operates its own and adjoining mills with 440-volt energy. Mr. J. T. Skinner is manager of the Lawrence company and laid out the installation above described.

THE FOUR-TERMINAL CONDUCTOR AND THE THOMSON BRIDGE.

In measuring large currents or large amounts of electrical power it becomes unfeasible to conduct the entire current through the measuring instrument, and an external shunt of known resistance must be employed in the familiar manner. Such a shunt may be termed a four-terminal conductor, inasmuch as it has two main terminals and two instrument terminals. The increasing demand for the accurate measurement of electrical power has necessitated the consideration of low-resistance standards of this type, capable of carrying very large currents. In a bulletin of the Bureau of Standards bearing the above title, Dr. Frank Wenner, assistant physicist, has discussed the theory and design of such four-terminal conductors and the use of the Thomson bridge method.

Owing to the large currents to be handled, the terminals must have ample surface contact to avoid heating. Using different current leads, or making the connections under different conditions, necessarily produces some variation in the current distribution in the main terminals, which sometimes extends to parts of the conductor between the potential terminals. As a result, the resistance frequently depends to some extent on the manner in which the current leads are attached. In order to be reliable, however, the standard must have a definite value of resistance, which must be determined in terms of the values of other standards. When alternating currents are used it is necessary also to know the inductance, or else that the phase angle between the current and the potential drop is negligible. Various methods have been proposed or employed in the comparison of the resistance of four-terminal conductors. The Thomson bridge method has been in use for over half a century, but has not been employed up to this time as extensively as its merits justify.

The bulletin points out the conditions which must necessarily be fulfilled in order that the resistance of a four-terminal conductor shall be definite, and the additional conditions which must be observed in order that the inductance shall be definite. It is shown that on using the four terminals in different combinations three, and only three, values for the resistance are obtained, and that one of these must be equal to the sum of the other two. It is pointed out that a symmetrical arrangement of the current and potential connectors, together with the use of branched potential connectors, makes the resistance sufficiently definite for the most precise measurements. The theory of the Thomson bridge, using both linear and non-linear four-terminal conductors, is discussed at length, dwelling on different methods of determining or eliminating the correction terms. The design of a resistance standard to carry a fairly large alternating current, which embodies some of the ideas discussed, is presented in the bulletin, and it is stated that, if certain of the mutual inductances can be neglected, there are definite relations between the resistance and inductance of the main ratio coils and the four-terminal conductors, and the frequency. When the time constants of all four of these conductors are small, it is shown that the relation between the resistance and the inductance is practically independent of the frequency.

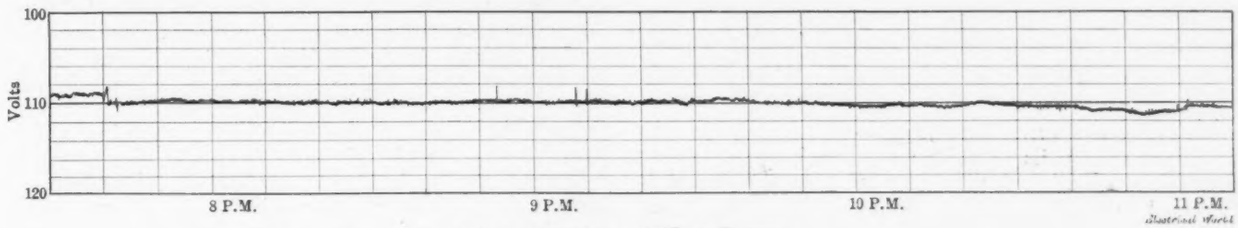


Fig. 3—Recording Voltmeter Curve.

RELATION OF THE HORSE-POWER TO THE KILOWATT.

Before the American Institute of Electrical Engineers, in 1911, adopted the value of 746 watts as the exact equivalent of 1 hp, there was no generally accepted or authoritative equivalent, and different values could be found in various reference books. According to the A. I. E. E. definition the horse-power is the rate of work expressed by 550 ft.-lb. per second at 50 deg. latitude and sea level, which is approximately the location of London, where the original experiments were conducted by James Watt. The number of foot-pounds per second in a horse-power accordingly varies with latitude and altitude.

In Circular No. 34, lately issued by the Bureau of Standards and entitled "The Relation of the Horse-Power to the Kilowatt," it is announced that the equivalent of 746 watts will in the future be used by the bureau as the exact equivalent of the English and American horse-power. The horse-power tables in the bureau's tables of equivalents formerly assumed that 550 ft.-lb. per second is the correct equivalent at 45 deg. latitude, which gave the rather inconvenient relation that 1 hp was equal to 745.6494 watts. The Continental horse-power, which is employed in Europe, is likewise most conveniently defined as 736 watts, the equivalent of 75 kilogram-meters per second at a latitude of 52 deg. 30 min., or that of Berlin.

Part one of the bulletin cites a number of values of the watt-equivalent of the horse-power taken from standard reference books, and discusses the reasons for the discrepancies. The original experiments of James Watt, who defined 1 hp as 550 ft.-lb. per second, are described in part two. Part three takes up the equivalents of the English and American horse-power, and part four the equivalents of the Continental horse-power. In part five it is pointed out that if the horse-power is to represent the same amount of power at different places, its relation to the watt must be a constant number, and the equivalent number of foot-pounds or kilogram-meters per second must vary from place to place, as shown in some of the tables in the bulletin. Primarily the watt and kilowatt are defined in purely mechanical terms instead of electrical, and the fact that these units have been employed so extensively in electrotechnical work is due merely to the fact that they are metric units and hence conform naturally with the system of units in which electrical quantities are universally expressed. Any kind of power may properly be measured in kilowatts instead of horse-power. The watt is defined directly in terms of fundamental units of mass, length and time, and is the power developed when a velocity of 1 m per second is produced by a force which is capable of imparting in one second to a mass of 1 kg an acceleration of 1 m per second.

VALUE OF THE ENGLISH AND AMERICAN HORSE-POWER (746 WATTS) AT VARIOUS LATITUDES AND ALTITUDES.

Altitude.	Lat. 0 Deg. (Equator).	Lat. 30 Deg.	Lat. 45 Deg.	Lat. 60 Deg.	Lat. 90 Deg. (Pole).
Sea level.....	551.75	551.01	550.28	549.55	548.82
5000 ft.....	551.92	551.18	550.45	549.71	548.98
10,000 ft	552.08	551.34	550.61	549.88	549.15

Modern practice is tending toward the use of the kilowatt instead of the horse-power, and this practice the bureau recommends. The bureau also expresses the hope that engineering societies and other interests concerned will recognize the value of the English and American horse-power as 746 watts, or 550 ft.-lb. per second at 50 deg. latitude and sea level, employing the table given above to obtain the value in foot-pounds per second at other places.

STORAGE OF COAL AND SPONTANEOUS COMBUSTION.

Coal stored in large quantities for long periods deteriorates in quality, and it is of importance to determine whether the percentage of loss of heat value is great enough to make the aggregate loss in a large stock a serious matter. In a paper recently presented before the Pittsburgh Section of the American Chemical Society Mr. Horace C. Porter gave a large number of interesting data obtained from coal consumers who store coal in quantities up to 500,000 tons in one pile. The principal object of the investigation was to determine whether the loss in heat units in coal stored a certain period of time means a loss of money sufficient to justify the cost of under-water storage or other protective equipment or arrangements.

A few instances of commercial trials in the United States of submerged storage are known, but the practice has not become general by any means. The Western Electric Company, at Hawthorne, Ill., installed in 1907 a submerged storage plant of concrete construction for 10,000 tons. After two years' storage it was found that the submerged coal had a heating value about 2 per cent greater than that of a similar coal which had weathered two years. This difference hardly justified the expenditure of $70,000 for the construction of the plant and 7 cents per ton for hauling, but the insurance against all risk of spontaneous fire in the stock may be considered to have been in itself sufficient justification.

The Bureau of Mines has recently concluded a number of tests extending over a period of two years to determine the amount of deterioration caused by weathering four different kinds of coal—New River coal from the Sun mine, Fayette County, W. Va., a smokeless coal containing about 20 per cent volatile matter; Pocahontas coal, a type similar to New River coal; Pittsburgh gas coal, which was examined in order to study its deterioration in gas-making qualities, and Sheridan (Wyo.) sub-bituminous coal, or black lignite. With the New River coal stored two years the loss varied between 1.8 per cent and 0.9 per cent for weathered coal, while there was practically no loss in under-water storage. Pocahontas coal lost 0.4 per cent and Pittsburgh gas coal lost practically nothing in one year's weathering. The Wyoming coal lost in one case 2.5 per cent in the first three months and over 5 per cent in two and three-quarter years' weathering. It had slacked badly on the surface, but the slacking did not penetrate more than 18 in. With New River and Pocahontas coal there was no apparent slacking of lumps or physical deterioration in the run-of-mine. In all cases the ¼-in. crushed coal exposed to the weather deteriorated in heat value more than did the run-of-mine, and deterioration was greater in warm climates.

Reports of other tests seem to corroborate in some degree the results of those mentioned above. Pocahontas coal kept under cover for four years at Sitka, Alaska, by the Navy Department showed a loss of 0.7 per cent. The coal recovered from the battleship *Maine*, sunk in Havana harbor for fourteen years, lost only 1.9 per cent. The origin of this coal has not been fully established, but there are good grounds for supposing that it came from a mine in the New River district, West Virginia.

Spontaneous combustion, according to the author, no doubt results from an accumulation in a combustible material of the heat produced by oxidation or the heat of other chemical reactions, of fermentation, or of bacterial action. Tests have shown clearly that coal exposed to air undergoes oxidation and that some kinds are more rapidly affected than others. However, some coals which in these tests showed little or no heat development have in practice proved to be dangerous to store, which condition has led to a consideration of factors other than ease of oxidation; that is, the effect of physical conditions of storage on accumula-

tion or dissipation of heat. A committee of the Railway Maintenance of Way Association recently reported that in its opinion the presence of dust in a coal stock was the prime cause of spontaneous combustion. Other authorities have expressed similar warnings. An instructive instance from commercial practice is furnished by the Calumet & Hecla Mining Company. At the Tamarack coal dock near Houghton, Mich., a stock of 100,000 tons of Pittsburgh run-of-mine coal was continually giving trouble with spontaneous fires until some time ago, when provision was made for screening the coal before storing. The fine coal was used immediately and the lumps were stored. Practically no trouble with fires has been encountered since this system was employed. It is often noticed that after a heavy rain or alternate wetting and drying an open coal pile becomes heated spontaneously. This is possibly due to the washing of dust down into a compact layer 2 ft. or 3 ft. below the surface, where its under portions start to heat and are protected from cooling air currents.

In conclusion the author states that some kinds of coal are more liable than others to heating or spontaneous combustion. Bituminous coals of all sorts are more liable to be affected than other kinds. Storage piles over 15 ft. deep are dangerous. A mixture of fine coal with a small quantity of lump, which provides access for a limited amount of air, affords great opportunity for heating. Freshly mined or freshly crushed coal heats most easily. By rehandling after two months' storage risk of spontaneous fires can probably be avoided.

APPLICATION OF ELECTRICITY IN AGRICULTURE.

The utilization of electrical energy in agricultural service was the subject of a paper that was presented at the recent convention of the New England Section of the National Electric Light Association. The author, Mr. C. H. Miles, of the Edison Electric Illuminating Company, Boston, Mass., emphasized the increasing interest in agriculture and the great opportunities for electricity in farm service which will in time tend to offset the high cost of living. Consumption of energy for farm service is nearly all off-peak demand on the station and is economical for the farm. The author reviewed the work done by the Electric Farming Tent Exhibit of the Boston Edison Company, which has already been visited by 10,000 people in the outlying suburbs of Greater Boston. It is estimated that by irrigation land in New England can be made to yield from 50 to 100 per cent more in crops than by depending solely upon natural water supplies. Growers in the market-gardening town of Arlington, less than 10 miles from Boston, are using land worth $1,000 per acre, and the Edison company has recently replaced a steam pumping installation in this town with a 25-hp motor driving a De Laval centrifugal pump at 3600 r.p.m. and pumping about 200 gal. of water per minute against 90 lb. pressure. The cost of this energy is but little more than was formerly paid for attendance on the steam pump, and about 30 per cent more water is delivered at a moment's notice. The water in this installation is used through open hose and a series of small nozzles placed horizontally in a supply pipe fixed about 2 ft. above the ground, the application of water resembling natural rainfall. During the dry period in June and July of the present year the plant was in constant operation and the cost of energy was only about $4 per month per acre. The former engineer of the steam plant has been set at work on the farm. Authorities have estimated that animal horse-power costs 8 cents per hour, and manual labor, ⅛ hp, a minimum of 11 cents per hour, so that wherever it is possible to supplant these two sources of power by electricity marked economy will result.

The rest of the paper was devoted to a review of the applications of electricity on the farm which have been found advantageous. At present there are many items of waste on the farm which can profitably be utilized by the application of power, one of the most important being the shredding of cornstalks for cattle feed. The motor-driven oat crusher works along similar lines, and it is estimated that a horse receiving 12 quarts of oats per day will thrive equally well upon 9 quarts of this high-cost feed when crushed. Tests of this work show that the grain can be crushed finely for an expenditure of less than ⅕ kw-hr. per bushel. Tests show that in milking cows by electrically driven equipment the energy consumed is approximately 1 kw-hr. for each fifty animals. Many opportunities exist for the use of electricity on the farm, including electric-vehicle deliveries of milk, the operation of pumps, separators, churns, cider mills, grindstones, domestic motors and lighting equipment.

In the discussion which followed the reading of the paper Mr. H. D. Larrabee, Montpelier, Vt., emphasized the advantageous conditions of his territory for application of electric energy in farming, and stated that advertising matter sent to prospective customers along rural lines had met with a very favorable reception. He expressed the opinion that such matter obtains more consideration from country dwellers than from persons living in or near towns. In outlining the rural applications in the Montpelier district the speaker said that in one case a 2300-volt line was extended 3.5 miles, forty customers being supplied with energy chiefly for lighting. Thirty-one electric flatirons were sold in two months. In other instances, where motors of from 1-hp to 3-hp rating were installed for farm service, a 2.5-kw pole-type transformer and a 20-amp meter were installed at each place. A high-tension transformer costs more than a low-tension outfit, so that where farm service is rendered from high-voltage lines the need of a separate transformer at each installation makes it desirable to secure an adequate return from the investment. On a line distributing energy at, say, from 6600 volts to 13,000 volts, the speaker suggested that the revenue from a given extension should be in the vicinity of three times that obtained from a corresponding 2300-volt lead, in order to insure a reasonable profit. In a specific instance where a farmer desired service to operate an ensilage cutter, cream separator and other small apparatus it was found that a necessary thirty-five-pole extension would be unprofitable.

Mr. R. S. Hale, Boston, said that unless the average farmhand has had experience he is afraid of the electric motor, and a campaign of education is therefore important. The situation is analogous to the development of the gas range, the early days of which were clouded by a skeptical attitude on the part of cooks. It is plainly the duty of the central station to induce the farmer to give electrical apparatus a trial and to become a devotee of its use. The companies should purchase oat crushers and place them in service on trial, showing the farmer their actual economies under the conditions of regular use. If the installation does not pay, the central station should take back the equipment and the farmer should not be required to pay for it. After installation the company should lose no opportunity to follow up the working of the equipment in service, keeping the farmer posted in regard to its efficient use and seeing to it that proper repairs are made. Where a company sends out apparatus to farmers for such a free trial there is no discrimination. Solicitors should find locations where such equipment will pay and induce the farmer to let the company place it in service on trial.

Mr. Eugene Carpenter, Oak Bluffs, Mass., referred to an educational campaign conducted by the Vineyard Lighting Company to induce more people in its territory to take up agricultural pursuits, and he emphasized the point that electricity is eliminating farm drudgery. The central station should co-operate in educational movements for the betterment of the farmer. At Martha's Vineyard courses on farming have been added to the high-school curriculum as

a result of the company's efforts. The central station should take an interest in the welfare of the grammar-school boys, 98 per cent of whom do not go to college. Mr. Carpenter suggested the possibility of encouraging the farmer to establish some sort of electrically driven shop at home for winter service. Referring to the benefits of electric irrigation under New England conditions, the speaker cited the opportunity to increase the local output of market-garden products by the employment of central-station service. In a representative plant in his territory a motor-driven pump is operated between midnight and dawn on alternate sections of the farm, giving an artificial shower every fifth night. Such service fills in the central-station valley and also enables liquid insecticides and fertilizers to be sprayed as required. The treatment of milk by electrical methods in the dairy offers another useful service whose object is the prolongation of good conditions.

Secretary T. Commerford Martin, of the national organization, said that efforts are being made to establish a division of farm power in the Bureau of Irrigation at Washington, and he suggested that low rates are essential for the success of this kind of service. Mr. Taylor, Poughkeepsie, N. Y., cited the extension of a central-station 2500-volt feeder 1.5 miles to serve thirty-five farmers, resulting in the shutting down of six windmills, the installation of three electric fireless cookers, several washing machines, an electric incubator and a flatiron in each case. On a model dairy farm having fifty cows a 2-hp motor-driven milking outfit is in service, four cows being milked simultaneously. A 9-cent power rate is in force. Mr. J. A. Fleet, Portland, Me., suggested the possibilities of co-operation among farmers in building pole lines, and said that at least 20 per cent should be realized on the investment in rural distribution.

ELECTRIC COOKING IN THE UNITED STATES NAVY.

According to the plans of the United States Navy, electric energy will be largely employed in the future for cooking and for operating the galley labor-saving machines on board the battleships because of its cleanliness, efficiency and convenience. By adopting electricity for cooking, coal, ashes and coal gases will be eliminated and preparation of the food, such as the peeling of vegetables, mixing of dough, etc., will be performed by machinery instead of by hand. In electric cooking the heat is produced locally, only when desired, and is instantly turned off when not required. This, together with the asbestos heat insulation, greatly reduces stray radiations, rendering the galley and surrounding compartments more habitable. The large power demands are for short periods only and can readily be met by the ship's dynamos.

The exact temperatures desired for cooking may be promptly obtained and nicely regulated. No smoke pipes are required, thus permitting greater latitude in location and arrangement of ranges and ovens. No attention to fires is required and no galley coal is needed; on oil-burning ships this would otherwise have to be specially provided for. Much saving of labor, which can be otherwise employed, results from the use of machinery for preparing foods.

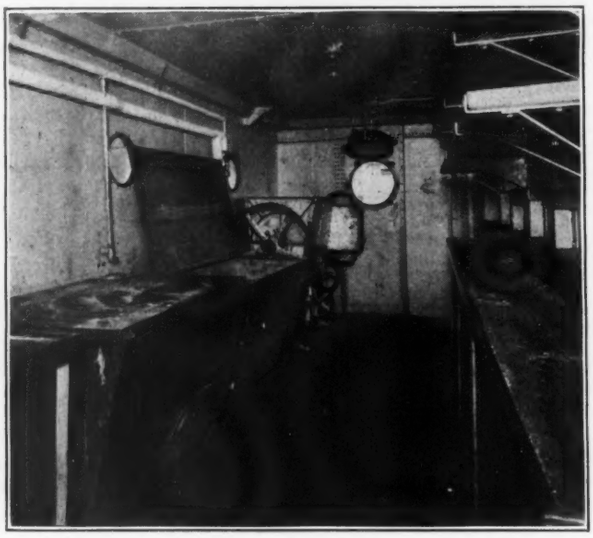


Fig. 2—Bakery with Electrically Driven Dough Mixer.

The entire complement of over 900 officers and men on a modern battleship is served by a commissary branch of approximately sixteen men. Such a vessel would have an officers' galley with four sections of range, a crew's galley with eight sections of range besides other miscellaneous appliances to be noted later, a bakery, a general mess pantry where dishes and cutlery are washed and stored, besides a butcher shop and a cold-storage plant.

Fig. 1—View Through Starboard Door, Showing Electric Ranges.

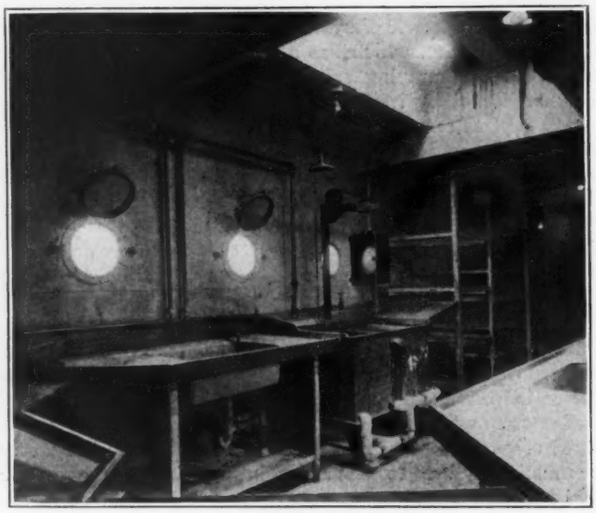


Fig. 2—View of the Pantry with Electric Dish Washer.

A typical electric galley equipment operating at 120 volts, direct current, was recently installed on the U. S. S. *Wyoming*, recently placed in commission, and is illustrated and described herewith.

The galley equipment includes electric ranges, an egg and cake machine, meat grinder or food chopper, meat slicer and vegetable peeler. Each section of electric range contains an oven, a broiler, four hot plates and a switch cabinet above. The ovens are capable of reaching a temperature of 500 deg. Fahr. within forty minutes; the broilers will attain a bright red heat within three minutes and the hot plates will reach 750 deg. Fahr. within eighteen minutes. When all heater units are in full operation, the maximum power required per section is 31 kw. A 1-hp motor is employed to drive the egg and cake machine.

The meat grinder is driven by a ¾-hp motor and has a capacity of 300 lb. of raw beef or 700 lb. of raw pork per hour. In place of the meat grinder a meat and food chopper, capable of mincing all sorts of food and requiring a 3-hp motor, is sometimes supplied. The meat slicer is also motor-driven. The electrically driven vegetable peeler is capable of peeling 1000 lb. of potatoes per hour, and requires a 1-hp motor.

The bakery equipment consists of electric ovens and a motor-driven dough mixer. Size No. 1 of electric oven has a capacity of eighty-four 24-oz. loaves of bread per hour, while size No. 2 has a capacity of fifty-six loaves per hour. In the neighborhood of one hour is required for a No. 1 oven to reach a temperature of 500 deg. Fahr. This size of oven uses 15 kw on high heat and half this power on low heat, with an output of 12 lb. of baked bread per kw-hr.

The general mess pantry is equipped with an electric dish washer, which has a capacity of 6000 pieces washed and rinsed per hour. Power is supplied by a 1-hp motor. Motor-driven ice-cream freezers are also being supplied for the larger vessels. These freezers have a capacity of 200 quarts in two hours and require a ½-hp motor.

FURNACE ARRANGEMENT FOR BURNING OIL.

The Pacific Gas & Electric Company, San Francisco, Cal., possesses eleven hydroelectric stations, situated at an average distance of 200 miles from San Francisco, and floating on the line with these stations are three steam-turbine stations. The latter act as line regulators at very small cost for fuel, and by means of oil fires it is possible for the operating department to pick up load to the maximum rating of the turbines without any notice and without any drop in the voltage. This condition has occurred a number of times and has been handled without inconvenience to the company's customers. On these occasions the steam pressure dropped as low as 150 lb. pressure from 200 lb., but was brought up to normal again in from ten to fifteen minutes. In relieving the hydroelectric stations of from 10 to 20 per cent of their load instantly, it has been found that most emergencies can be taken care of and that no serious outages occur. By this means of operation a very flexible system is evolved, whereby a duplicate source of supply is available in all districts, and fuel is not used except at such times as the hydroelectric power is unavailable.

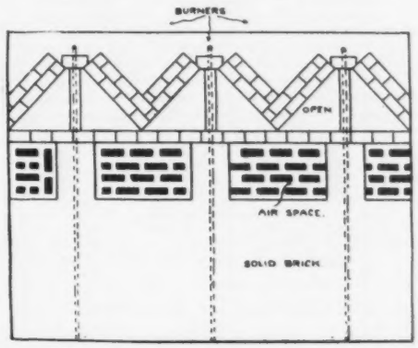
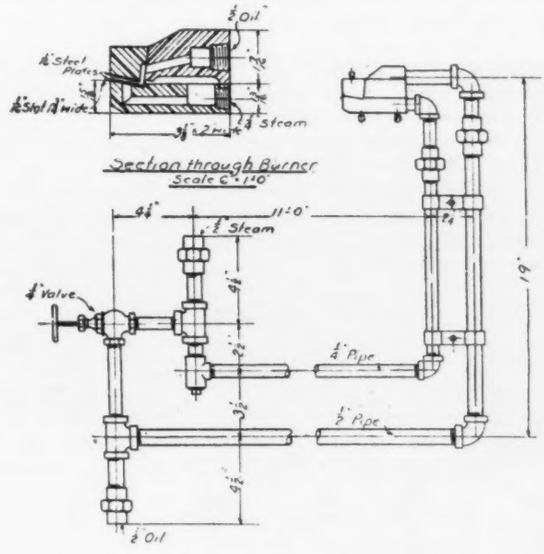
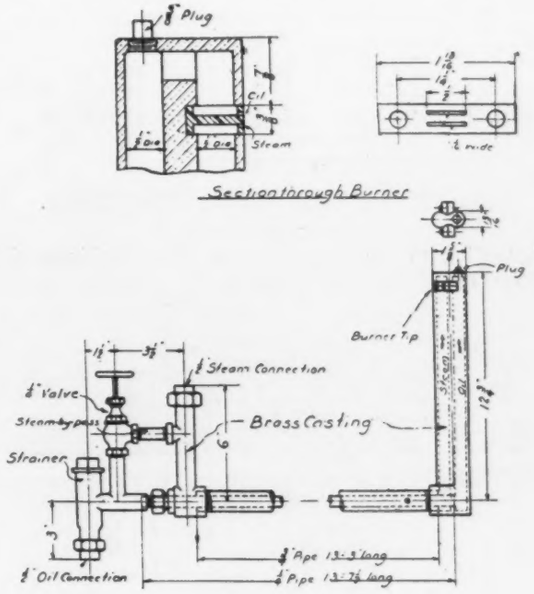


Fig. 3—Plan of Oil-Burning Grate for 520-hp Water-Tube Boiler.

It is the aim of the operating department to run the hydroelectric stations at as nearly 100 per cent load-factor as possible and to carry the peaks with the steam electric station. It is not unusual to work boilers at 80 per cent efficiency on regular commercial operation, while under like conditions with coal 70 per cent boiler efficiency would be considered good. The heavy-gravity California oils show better economy in operation, since they contain a greater number of heat units per 42-gal. barrel. The furnace arrangement for oil burning is all important, and it is possible so to equip a furnace that for the average load on the boiler proper combustion can be had without regard to the firemen. Thus, in one of the plants of the Pacific Gas & Electric Company, which is equipped with twenty-seven boilers having a total heating surface of 156,300 sq. ft., two or three boilers are used for regulation and the other boilers are set for economical conditions and are not disturbed except on extreme fluctuations of load, when they are cut in and cut out one at a time by turning the oil valve and handling the dampers.





Figs. 1 and 2—Representative Inside and Outside Mixture Types of Burners for Steam Boilers.

Mr. F. H. Varney gave some information on the arrange-

ment of the oil-boiler furnaces of the company at the recent convention of the Edison association. In arranging the oil burners and furnaces for boilers having vertical baffles and inclined tubes it has been found that best results are attained by using "back-shot" burners. The oil pipes are run through the ash pit under the furnace floor to the

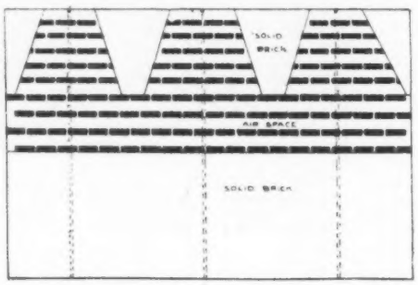


Fig. 4—Plan of Oil-Burner Grate for 680-hp Water-Tube Boiler

bridge wall and turn up into the furnace with the flame toward the boiler front. The floor of the furnace consists of loose firebrick laid on the grate bars or other supports, with suitable openings in the brickwork for the admission of air. The air inlet is made to conform to the shape of the flame, which is naturally V-shaped. The air spaces are readily determined and easily formed with the loose brick, and in this way the fireman can be instructed regarding the oil and atomizing steam pressure to the burners for a given load, so that no damper adjustment is necessary, the air supply being fixed by the amount of space openings on the furnace floor.

The arrangement of the furnace and flame is such as to provide uniform distribution of heat over the entire furnace, localized heat impinging on a small area of the tube being avoided. The furnace for a 600-hp boiler should be not less than 10 ft. deep, with an air inlet extending 4 ft. from the burner, and should be from 6 ft. to 8 ft. high at the front end. There are two distinct types of burners used, known as the inside-mixture and the outside-mixture burners, depending on whether the steam used for atomization is mixed with the oil before it leaves the burner or after. Figs. 1 and 2 show the two types and indicate representative burners in use at the present time. According to Mr. Varney, best burner efficiency is obtained when the tip is of the proper size and shape to suit the individual furnace.

CENTRIFUGAL BOILER-FEED PUMPS.

According to the committee on steam turbines of the Association of Edison Illuminating Companies, the multi-

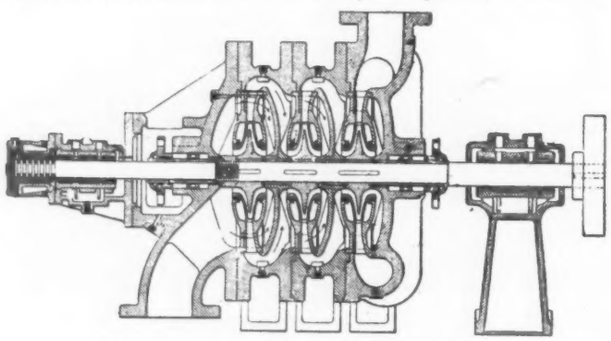


Fig. 1—Double-Suction Boiler-Feed Pump.

stage centrifugal pump is rapidly becoming the standard type of boiler-feed pump, at least in large generating stations. The pump is well adapted to boiler-feed work, since it supplies a steady, continuous flow of water. There is therefore no danger of shock or water hammer.

Regarding the lubrication necessary, the centrifugal pump is much more satisfactory than the reciprocating type of pump so largely used. As there are no reciprocating parts, the question of lubrication is not serious. The oil is fed automatically to the bearings by means of rings and it is only necessary to fill the oil wells occasionally.

The maintenance of a centrifugal pump is very low. It might be said that the only trouble so far developed lies in

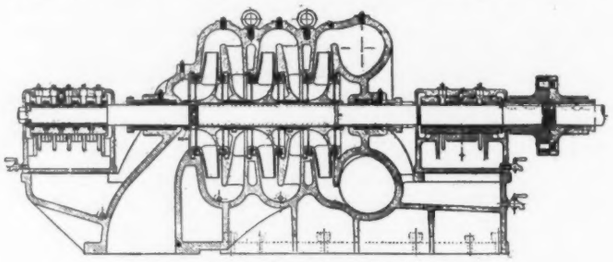


Fig. 2—Three-Stage Centrifugal Pump.

the corrosion of the pump casing and diffusion blades caused by the presence of salt in the feed water due to condenser tube leakage in those cities employing salt water for condensing purposes. Condenser tubes are readily replaced, but corrosion of the pump casing and diffusion blades constitutes a serious trouble. One large central station has installed boiler-feed pumps with bronze casings in order to eliminate the corrosive effects.

Very little attention is required by centrifugal boiler feed

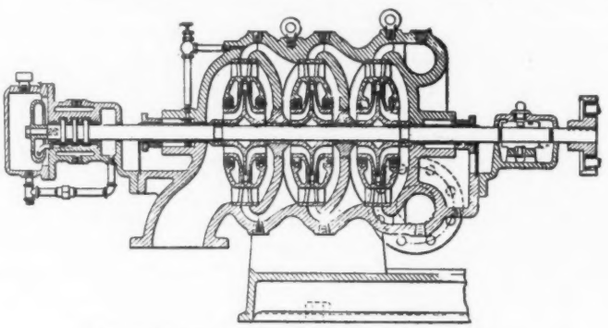


Fig. 3—Three-Stage Double-Suction Pump.

pumps since the machines operate automatically and generally require merely to be started and stopped when needed. A majority of the manufacturers have decided on two-stage or three-stage pumps for their standard types with speeds varying from 2000 r.p.m. to 3000 r.p.m. The committee has not yet decided whether the double-suction impeller type gives more satisfaction in operation than the single-suction pump. Likewise the subject of diffusion vanes is one on which the manufacturers are not yet in

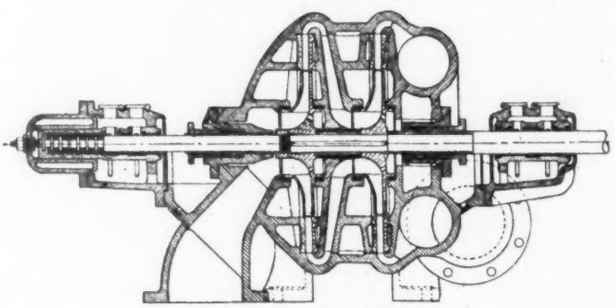


Fig. 4—Two-Stage Boiler-Feed Pump.

agreement. The omission of the vanes eliminates any necessity for replacing them when worn, but their omission entails a sacrifice in efficiency. Whether the advantages of the vanes counteract the disadvantages is still a mooted question. Sections of some of the principal boiler-feed pumps now on the market are reproduced herewith.

Central Station
Management, Policies and Commercial Methods

BATTERY SEARCH-LANTERN FOR LINEMEN.

The overhead-line trouble department of the Topeka (Kan.) Edison Company makes good use of a battery-operated search-lantern when required to do night repair work. A regular 12-in. automobile search-lantern is employed with a 12-cp, 6-volt tungsten lamp, the largest made. The lantern is pivoted in the socket of the 3-ft. iron tripod which was built in a local blacksmith shop. With its double trunnions, the lantern can be turned and held in any position. A 60-amp-hour ignition-type storage battery supplies energy through an 8-ft. length of flexible cord. This battery needs to be charged only two or three times a month and is always kept ready to be placed in the trouble wagon with the lantern for emergency use.

DEMAND CONTROLLER AS ACCESSORY TO METERED SERVICE.

The Beatrice (Neb.) Electric Company makes a rate of 13.5 cents per kw-hr. for the first thirty hours' use of the customer's connected load, beyond which the schedule reduces to 6 cents per kw-hr. One dollar is the monthly minimum, in addition to a 25-cent meter charge, the latter being added to all bills regardless of consumption. In the case of several customers who desired to have a large number of outlets available, although the full number is seldom used, the company has furnished, for $8, a flat-rate controller to be connected in circuit behind the meter, thus limiting the demand to the value set by the overload coil. This limit then becomes the maximum charged for by the company, and the customer reaches the "turning point" in his rate at a lower consumption than with the full number of lamps. The flat-rate controllers used have been of the hot-wire type, and are sold outright to the customers for $8 each. By such an investment, one customer who had fifty lamps, not more than fifteen of which were used at one time, reduced his minimum bill from $10.37 to $3.29 per month. And for 90 kw-hr. consumed by fifteen 50-watt lamps operated four hours daily he paid $7.34 instead of the $11.27 it would have cost him under the full schedule.

For long-hour users, such as saloons, poolrooms, drug-stores, etc., the Beatrice company has an optional rate of $3 per connected kilowatt per month, plus 4 cents per kw-hr. for energy used. This long-hour rate is also susceptible of the controlled-demand limitation, so that for certain classes of business the rate is a most desirable one for the customer as well as the central station.

BAITING FOR THE UNWARY PROSPECTIVE CUSTOMER.

A keen-witted new-business manager who keeps on tiptoe for prospective customers in his town of 12,000 goes through the "want ad" columns in the local newspapers each day and locates the telephone addresses of those advertising houses and rooms for rent. This list is turned over to the woman office assistant, who in odd moments calls up the numbers and, after preliminary inquiries about the condition of the premises, price, etc., asks if the house is lighted by electricity, closing the conversation with the remark that she "could not think of being without electric light." The same list is then passed on to a solicitor, who also calls up and goes through the same form of inquiry. A few days after the second call, allowing time for the house owner to reflect on the situation, he receives a casual visit from the solicitor, who usually finds much of his way for closing the contract smoothed in advance.

This same central station serves a college town. At the beginning of the last school term two students were employed at $1.50 per day to call on 105 unwired rooming-house addresses, "look at" the rooms for rent, ask the price, etc., but finally depart unsatisfied after calling attention to the absence of electricity for lighting. One student could reach about thirty houses per day, and the lists were exchanged so that each man called on the entire 105 addresses. A few days later a solicitor paid the landladies a visit and found some of them so interested that eighteen house-wiring contracts were closed as a direct result of this stunt.

LIGHTNING DETECTOR FOR 250-FT. CONCRETE STACK.

A 250-ft. concrete stack has just been completed at the plant of the Topeka Edison Company. This tall monolithic structure, as high as the Kansas State Capitol near by, is 24 ft. in diameter at the base, where its walls are 2 ft. thick, and it tapers upward to 16 ft. in diameter at the top with 8-in. walls. Its foundations measure 34 ft. square and 16 ft. deep. The stack was built by the General Concreting Company and for lightning protection is provided with a corona of six discharge points grounded by two ¾-in. copper cables. In one of these conductors is inserted a lightning detector, made by Carl Bajohr, St. Louis. Bridged around a shunt resistance which it contains is the trip coil which releases the pointer. When set, the arrow is pointed upward, but upon being released by a lightning discharge it rotates 180 deg. and points toward the ground, reporting the passage of the lightning discharge.

Lightning Discharge Indicator.

ELECTROLYTIC MANUFACTURE OF HYDROGEN AND OXYGEN AT OMAHA.

Increasing use of the oxy-hydrogen and oxy-acetylene flames for welding and cutting metals has developed much interest in commercial methods of generating hydrogen and oxygen electrically by disassociation of water. For several years hydrogen for balloon purposes has been manufactured electrically on a large scale at the government fort near Omaha, Neb. Only the hydrogen is there utilized, the oxygen by-product being wasted. Electrolytic hydrogen has also been made for inflating test ballonets sent up by the weather bureau.

The Balbach Chemical Company, at Omaha, is now replacing its former chemical equipment for the manufacture of hydrogen and oxygen by electrolytic tanks which will have an output of 2700 cu. ft. of hydrogen and 1350 cu. ft. of oxygen per day, measured at atmospheric pressure. David Bournenville & Company, 515 Laflin Street, Chicago, are the manufacturers of this electrolytic equipment. A 50-kw motor-generator set will produce 7-volt direct cur-

rent for electrolyzing the twenty cells, which will be operated continuously twenty-four hours per day, making the load a desirable central-station acquisition. The Omaha Electric Light & Power Company, which has the contract, expects to supply about 25,000 kw-hr. per month to this plant, its rate being 3 cents per kw-hr. for the first 5000 kw-hr. and 2 cents for all in excess of this. The central station secured the contract in competition with an oil-engine isolated plant. Besides the main 50-kw motor-generator set, there is a 5-hp pump motor for compressing the gases to 200 lb. per square inch for shipment. At 2 cents per kw-hr. for energy, the cost of manufacturing hydrogen is understood to be 0.3 cent per cubic foot, and oxygen 0.5 cent. The output of the Balbach company is chiefly used locally for welding and cutting purposes, in connection with oxy-acetylene and oxy-hydrogen blowpipes.

BATTERY-DRIVEN TOWER WAGONS REPLACE GASOLINE TRUCKS.

A number of novel details, devised locally, distinguish the two new 2-ton battery-driven Trenton tower trucks recently put in service by the line department of The Milwaukee Electric Railway & Light Company. These electric trucks replace the gasoline engine-driven tower wagons which have been used in Milwaukee for several years. Contrasted with the former gasoline cars, the electric trucks are rendering dependable twenty-four-hour service for twelve days at a time, at the end of which period they receive a general overhauling. The gasoline wagons, on the other hand, had proved unreliable, were constantly in need of slight but vital repairs and could never be depended upon for heavy service. With their multitude of small but essential parts, the mechanism was constantly being racked to pieces by the shock of travel, so that the cars were "down" a distressing portion of the time.

The new Milwaukee electric wagons comprise standard Trenton towers on General Vehicle 2-ton trucks and are capable of speeds up to 15 miles per hour, which is found sufficient for all city work. Instead of being tumbled into the body of the truck in the usual manner, the jacks are

Electric Tower Wagon, Milwaukee.

arranged to slide into shoes on the sides of the rear step. These shoes hold the jacks upright and in an accessible position. Each jack base is drilled to receive a pin which also goes through the step, preventing the jacks from sliding out of their shoes and being lost. Each wagon has a 9-ft. by 3-in. by 4-in. wrecking bar, reinforced with iron plates. The sides of the bar are cut into a series of steps so as to carry axles or jack-heads securely. By means of coupling-pin holes in the bar and in the channel-iron buffer which protects the front of the truck, the bar can also be used as a push rod for pushing aside traffic obstructions. The wrecking bar is carried upright in a special socket alongside the tower. The ladders are also locked in place on the side of the tower, and there are pockets for hose cross-overs. Trolley wire is wound on the outer 4-ft. spool of the reel-within-a-reel, the inner 3-ft. wheel being occupied with span wire. Beneath the seats in the wagon body are the tools, arranged in trays, each tool fitting the socket it occupies. Four of these electric tower wagons will be used in Milwaukee, two others being on order.

A UNIT SCHEDULE FOR SOLICITORS' SALARIES.

By the plan of compensating salesmen in use at Lawrence, Kan., the solicitor virtually fixes his own monthly salary, which is determined by the effort he puts forth and the results accomplished. The scheme is based on a mini-

SOLICITORS' SALARY SCHEDULE, LAWRENCE, KAN.

	No. Points.
Each meter gained	5
Wiring residence on lines, minimum 200 watts connected load	12
Wiring residence, one extension, minimum 200 watts connected load	6
Wiring residence, one extension, minimum 500 watts connected load	12
Wiring residence on lines, minimum 500 watts connected load	25
Installing new work in commercial houses, lamps of 150 watts and over, per lamp	5
Wiring commercial houses, closing at 6 p. m.	10
Wiring commercial houses, not closing at 7.30 p. m.	25
Dead service, six months	15
Increased consumption in residences per 100 watts	2
Increased consumption in business houses closing at 6 p. m., per 100 watts	2
Increased consumption in business houses closing after 8 p. m., per 100 watts	5
Electric signs where sale is made by representative	40
Electric irons sold	10
Electric toasters sold	10
Heating pads	5
Disk stoves	7
Chafing dishes	15
Coffee percolators	15
Cigar lighters	10
Electric fans, 8-in.	5
Electric fans, 12-in.	6
Electric fans, 16-in.	7
Ceiling fans	8
Electric radiators	10
Electric ranges	20
Sewing-machine motors	10
Motors, per hp.	15
Washing machines	30
Outlining, per 200 watts.	5
Baseboard receptacles	3
Excess of five switches on one residence wiring, per switch.	3
Meters obtained in houses already wired where no extensions are necessary	5
Street lights on flat-rate circuit paying $2 per month	10
Cutting out gas for lighting, which means fixing gas outlets so they cannot be used, and where electric light bill is over $2 per month.	20
Canvassing territories, first twenty calls on one street where there are twenty houses, to be turned in daily with date and claim for points accompanying them	5
For collecting bad accounts, per dollar	2
For increasing minimum bills 50 cents per month or more over same month last year, taken from list prepared for that purpose.	5

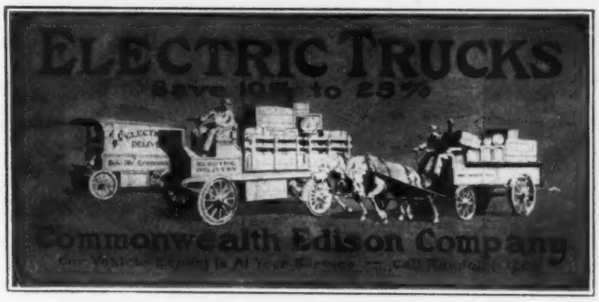
mum wage of $12.50 per half-month, to earn which the solicitor must make 250 points, as specified by the following schedule, each fifteen days. For each additional 100 points earned he receives $5. This business must be obtained personally by the salesman; accounts received at the office will not be credited unless it can be proved they had the representative's efforts fifteen days previously. Commissions are charged back and deducted if the installation fails to stay in sixty days. Points are allowed only on executed orders and bona fide orders to be executed within ten days.

Each employee at the close of the day makes out a state-

ment of his claim for points obtained during the day. This claim is filed with the new-business manager, who scrutinizes the items and passes them to the semi-monthly total, if correct. According to Mr. W. C. Duncan, manager of the commercial department, who devised this plan of remuneration, the minimum salary earned by any solicitor under the schedule has been $80 a month, and one man made $159 during a recent thirty-day period. The plan has been in use in Lawrence six months.

ADVERTISING OF ELECTRIC VEHICLES BY CENTRAL STATIONS.

In its constant endeavor to encourage the use of electric vehicles the Commonwealth Edison Company of Chicago has entered on a billboard campaign in addition to newspaper and other methods of advertising. Signs advocating the use of electric vehicles have been placed on thirty-five



Billboard Advertising of Electric Vehicles.

billboards located at vantage points about the city. One of these is illustrated herewith. The boards are illuminated by electric lamps at night and are about 25 ft. wide. The legends are changed from time to time by the advertising department of the Commonwealth company operating through the Thomas Cusack Company, sign maker. The entire expense is borne by the electric-service company.

SELLING IRONS TO MINIMUM-BILL CUSTOMERS.

Taking the records of his residence consumers, Mr. C. A. Bergen, contract agent at Emporia, Kan., recently selected fifty-six customers having minimum bills and wrote them a circular letter explaining that they were losing money by not making use of all the electricity they paid for. The letter suggested an electric iron as a convenience and comfort which could be operated within the surplus minimum limit of the monthly bill. The Emporia Railway & Light Company offered a standard electric iron for $4 cash, or $4.50 on distributed payments of 90 cents monthly. A free fifteen-day trial was also proposed. Of the fifty-six customers thus addressed, forty-six ordered and purchased irons.

PRESERVING POLES WITH WATER-GAS TAR.

The tarry fluid obtained from fuel oil during the process of generating water gas is utilized by the Lincoln (Neb.) Gas & Electric Company for preserving its poles, cross-arms, etc., the results after five years' experience indicating that this home-made "petrosote" compares favorably with several of the well-known preserving fluids on the market. Following the success obtained in thus protecting the company's line structures, the by-product oil tar is now being marketed locally, for general wood-preserving use, at 10 cents a gallon under the descriptive trade name above mentioned.

The fluid is drawn off from the seals of the water-gas generators and resembles in appearance the black, viscid quality of coal tar. Cross-arms are treated by dipping in an open tank. Poles receive two coats with a brush, the butts being thoroughly coated for a distance about 1 ft. above the ground line. Owing to the penetrative action of the petrosote, it is found to permeate the wood fiber to a depth of ⅜ in. to ¾ in. One gallon is enough to cover eight pole butts with two coats. As the preparation is an insecticide, insects are prevented from entering the fiber. The Lincoln electric-light company also uses the same oil-tar product as a paint for its wagons, buildings and steel work. By adding 1 gal. of Portland cement to 5 gal. of the tar a paint is formed which will adhere firmly to galvanized iron or steel and serves as a permanent protective coating. The ingredients are mixed just before using and kept well stirred while being brushed on. The tarry fluid also has applications as a disinfectant and insect destroyer.

"PAY US FROM WHAT YOU SAVE."

Mr. W. C. Duncan contract agent Lawrence Railway & Light Company, Lawrence, Kan., finds it easy to sell electric washing machines by using the argument: "Pay us out of what you save by using this machine." The washers are listed at $55 and are paid for $5 down and $5 a month.

The ordinary cost of doing a household's washing by hand he estimates at about $2 a week. The washer will perform this work in three hours at a cost of 2 cents per hour, or 6 cents per week. Hence there is a net saving to the housewife of $1.94 a week, or $7.76 a month, leaving her several dollars "pin money" each month.

VOLTMETER TEST BOXES AT DISTRIBUTION POINTS.

At each of the thirty distributing centers of its alternating-current system the Kansas City Electric Light Company has made provision for getting graphic records of the voltage regulation obtained. Special 1-kw transformers at each of these distinguishing-point poles have their secondaries wired down to connection clips in a permanent instrument box mounted on the pole 6 ft. above the ground. The interiors of these boxes are arranged with rests to hold standard portable curve-drawing voltmeters, which can be connected up and thus left in position to draw their own records twenty-four or forty-eight hours at a time. The boxes are covered with sheet metal and are provided with stout padlocks to protect them against tampering. They are also well up and out of the way of pedestrians, but can easily be reached by the instrument man with the aid of a chair or box. With the aid of the station instruments corresponding to the same feeds, a close check is obtained on the compensation necessary for each feeder's regulation.

Recording Meter Box and Potential Transformer on Cross-Arm.

CONTRACTORS' MOTOR-DRIVEN CONCRETE MIXER.

The motor-driven concrete mixer illustrated is one of several used by Lincoln (Neb.) building contractors which have proved good day loads for the local central station. The mixer shown is a ¾-yd. Link-belt outfit, and is driven through a belt and chain gearing by an 8-hp, 550-volt direct-current motor, the whole being mounted on wheels

Contractors' Motor-Driven Concrete Mixer.

to be portable. The contractor, Mr. W. Campbell, pays the Lincoln Gas & Electric Company 5 cents per kw-hr. and has abandoned the use of a gasoline engine set which was formerly employed for mixing concrete. Jobs on which the mixer is used last from one to four months, and the electric company makes the necessary service runs and extensions free of charge. On one job where the mixer above shown was used three months the customer's bills were respectively $16, $25 and $13 per month. Several Lincoln contractors also use motor-driven hoists for elevating brick and materials on office buildings, apartments, etc. The income from these little outfits, usually of 3-hp rating, averages $5 to $6 a month.

TWENTY-FOUR-HOUR SERVICE IN A TOWN OF 300.

Perry, Kan., a town with 300 population, recently completed the installation of a 17-kw oil-engine plant with battery auxiliary making twenty-four-hour service available to its forty customers. As the maximum transmission distance is but 1300 ft., a 125-volt two-wire direct-current system was chosen for distribution. Its 30-hp Alamo engine is at present using kerosene as fuel and drives a 17-kw generator. Counter-cell control is used for the E-9 chloride storage battery. Nightly, spanning the peak-load period, the engine set is run for about five hours, full load being maintained on the unit by charging the battery. During the rest of the twenty-four hours the storage cells are drawn upon for service. Energy is furnished for forty customers, a moving-picture show and twenty-nine street lamps. The commercial and residence rate is 10 cents per kw-hr., with $1 minimum. A special circuit feeds the picture show so that it can take energy only while the engine set is running. During the six weeks the plant has been running, a rate of growth wholly unexpected has been recorded. Installed, the plant with equipment has cost between $5,000 and $6,000.

BONUS AWARD FOR COAL-PER-KILOWATT-HOUR RECORD.

Each employee in the fire room of the Des Moines Electric Company's plant receives a bonus award of 1 per cent of his monthly wages for each one-tenth of a pound reduction in the plant's record of quantity of coal burned per kilowatt-hour below the limit fixed for that month by the chief engineer. This prize money is extended to all boiler-room employees, including ashmen, boiler washers, craneman, etc., in order to stimulate every man to his best efforts toward increasing efficiency.

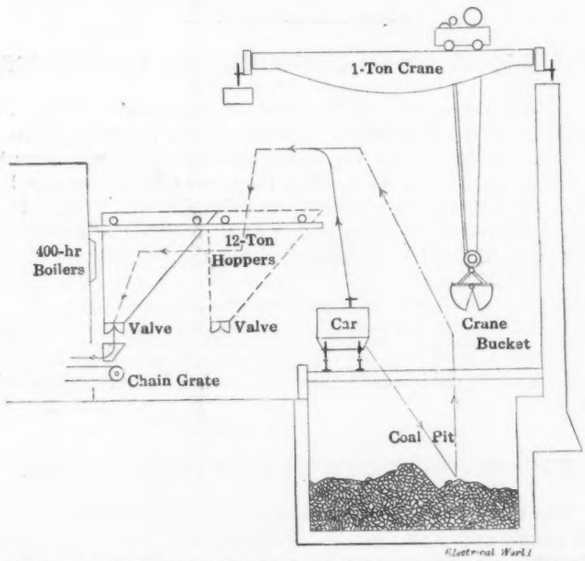
Firemen, of course, can contribute to improved combustion efficiency by preventing holes in the fires, keeping the draft low, giving attention to the water levels and holding steam pressure constant.

Flue-blowers can help by their diligence in keeping the flues in service and by giving notice of and repairing cracks or openings in the baffles or boiler settings.

The boiler washers aid the cause by keeping their tubes clean and free from scale and by reporting imperfections in time to prevent waste of steam.

Ashmen can help, too, by taking pains to inform the firemen each time before opening ash-pit doors, giving the men above an opportunity to slack up on the boiler, checking its draft and transferring the load to other units. The boiler-room foreman can render important aid by giving attention to the number of boilers in service, observing that each kind of coal gets the proper amount of wetting, inspecting non-return valves and headers, watching feed-water temperature and controlling its supply so as to be uniform. By proper mixing of the coal as he delivers it to the bunkers, even the man handling the bucket crane earns his share of the prize money.

The Iowa coal used at the Des Moines plant has a fuel value of 9500 to 10,000 heat units and an ash content ranging from 25 to 30 per cent, so that the records of combustion obtained are largely comparative and of only local significance. During the light-load summer months, June, July and August, 5.9 lb. of coal per kilowatt-hour is fixed as the maximum. For the rest of the year, when the load-



Arrangement for Handling Coal and Ashes at Des Moines Plant.

factor is higher, 5.7 lb. must not be exceeded in order to earn prize money. For each one-tenth of a pound reduction below these limits every fireman employee has 1 per cent added to his monthly wages. Last month the record was 5.7 lb. at the 5.9 lb. summer schedule, and 2 per cent bonus was given. A fireman earning $70 per month, therefore, received $71.40.

The sketch shows the method of handling coal to the four 400-hp Stirling boilers and chain-grate stokers. The loaded freight cars can be discharged directly into the concrete-lined pit, from which the movable hoppers are filled by means of the 1-ton Sprague crane, or the bucket can be filled directly from the cars and discharged into the hoppers. Each hopper holds 12 tons of coal, or 14 tons when heaped. At one end of the firing aisle is the ash pit, partitioned off from the main coal container. The same crane bucket is used to load cars with ashes from this ash pit. One man on the crane is able to handle the 90 tons of coal burned per day by the plant, besides the 20 to 30 per cent of ashes removed from the pits.

ILLUMINATING ENGINEERING FOR THE CENTRAL-STATION SALESMAN.

At the recent convention of the New England Section of the National Electric Light Association Mr. Ralph Beman of the National Electric Lamp Association, Cleveland, Ohio, presented a paper entitled "Illuminating Engineering for the Central-Station Salesman." The author pointed out that a sketch and estimate made on the ground in the presence of the prospective customer incline the latter toward the immediate signing of a contract for equipment and service, while delay often furnishes an excuse for him to change his mind and cancel his plans for an installation. Time is saved and errors are less probable, while the installation tends to conform more closely to the customer's wishes when the central-station salesman handles illuminating engineering work in the field. Data on illuminants, accessories and illumination design should be assembled by the salesman from every reliable source.

The paper contained the following tables of data for the use of central-station men, the first giving foot-candle intensities for various classes of service and the second utilization factors, a diagram also being included for approximate field work in the selection and placing of equipment.

Having decided the average intensity, which in turn determines the total light flux on the plane considered, the next step is to find what the total flux generated by the lamps must be. This depends upon the efficiency of the

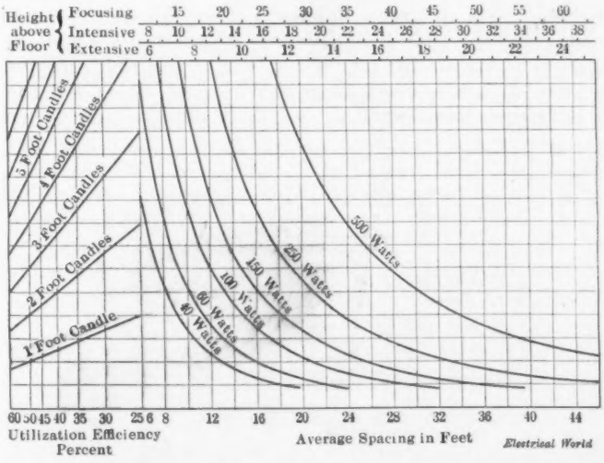

Height above Floor
Focusing 15 20 25 30 35 40 45 50 55 60
Intensive 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Extensive 6 8 10 12 14 16 18 20 22 24
5 Foot Candles
4 Foot Candles
3 Foot Candles
2 Foot Candles
1 Foot Candle
500 Watts
250 Watts
150 Watts
100 Watts
60 Watts
40 Watts
60 50 45 40 35 30 25 6 8 12 16 20 24 28 32 36 40 44
Utilization Efficiency Percent
Average Spacing in Feet
Electrical World

Chart for Approximate Calculations of Illuminating Equipment.

system or the ratio of lumens effective to lumens generated. Utilization efficiencies for different systems of light may be considered approximately as given in Table II. These tables have been compiled with the idea of being representative of results which may be obtained with new reflectors and lamps operating at rated efficiencies.

The use of the chart may be illustrated by an example. Assume a store requiring an illumination of 3 foot-candles and that prismatic glass reflectors are to be used. With medium walls take the utilization efficiency as 50 per cent. Using the left-hand portion of the drawing, find the vertical

TABLE I.—TABLE OF FOOT-CANDLE INTENSITIES RECOMMENDED FOR VARIOUS CLASSES OF SERVICE.

Art Gallery (walls)	5.0
Automobile.	
Showrooms	5.0
Billboard	8.0
Bowling Alley.	
Alley	1.0
Pins	4.0
Runway and seats	1.5
Card Room (tables)	3.0
Courts.	
Tennis	7.0
Drafting Room	8.0
Factory.	
General lighting (where individual drop lights are provided)	1.5
General lighting (where no individual lights are provided)	4.0
Local bench illumination	4.0
Gymnasium	2.5
Hotels.	
Bedroom	2.0
Corridor	1.0
Dining room	2.0
Lobby	2.0
Writing room	3.0
Library.	
Stack room	1.5
Reading room (with no local illumination supplied)	3.5
Reading room (with local illumination supplied)	1.0
Office.	
Desk	4.0
General (no drop lights)	4.0
General (with drop lights)	1.5
Show Window.	
Dark goods	20 0
Light goods	12.0
Store.	
Clothing	6.0
Furniture	3.5
Grocery	4.0
Hardware	3.5
Shoes	4.0
Warehouse	1.0

line corresponding to 50 per cent efficiency and follow it upward till it intersects the oblique line marked 3 foot-candles. If one follows the horizontal line passing through this intersection over to the other portion of the drawing, it will be found that it intersects the curves representing the several units in as many points.

The abscissas of each of these points give the spacing necessary to obtain the given intensity with each unit. In

TABLE II.—UTILIZATION FACTORS.

Unit.	WALLS. Light.	Medium.	Dark.
Prismatic glass	60	50	40
Opal or milk glass	50	42	33
Decorative or art glass	30	25	20
Semi-indirect	40	35	30
Indirect	Average value 30		
Steel*		Wide Angle 58	Narrow Angle. 50

*Values for steel will vary 10 per cent either way, depending upon conditions. They hold only when ratio of mounting height to smallest dimension of room is not greater than 1:2.

the case in hand 40-watt lamps should be spaced at intervals of 7½ ft., 100-watt units at 12 ft., 500-watt units at 28 ft. The size of unit will be determined by the size of room and diffusion desired. The proper height above working plane can be read from the upper scales. Types of distribution will be chosen according to the ceiling height.

The use of the two tables and the chart enables a salesman to specify size, spacing, height of suspension and light distribution from the unit, which in cases of uniform illumination is usually sufficient.

Wiring and Illumination

BRONZE LAMP-POSTS GIFT OF COLLEGE CLASS.

It is the custom for college classes upon graduating to present their alma mater with a class gift, usually some campus ornament, such as a stone seat, fountain, entrance gate, etc. The novel and excellent choice of present made by the 1912 class of the Kansas State Agricultural College, Manhattan, deserves to be brought to the attention of undergraduates in other institutions. This Kansas class appropriated $565 for the four handsome bronze lamp standards erected in front of the assembly building, where they have proved both useful and ornamental. The installation was made by the school's electrical engineering department, of which Prof. B. F. Eyer is the head.

Bronze Lamp-Posts, Kansas State College

POLE-HEIGHT ESTIMATOR.

When a tree, telephone line or other obstruction is to be crossed, the usual practice is to send an experienced lineman to judge the height of pole needed. This man estimates the height of the object above the ground, adds what he thinks is the necessary amount of clearance and the distance which the butt is to be set into the ground, and turns in his report of the length of pole required. But when the pole is delivered to the site it is too often found that the estimator has allowed too much margin in order to be on the safe side, and that, say, a 35-ft. pole has been ordered where a 30-ft. stick would have served. Or—a more serious matter—the height may have been underestimated, so that the wires will not clear the obstruction. Another pole must then be hauled out and the first pole returned. Such errors on either side of the actual requirements mean waste of material, time and labor.

Fig. 1—Lineman Using Pole-Height Estimator.

The line department of The Milwaukee Electric Railway & Light Company is making use of a pole-height estimator, a pocket device originated by Mr. S. B. Way and Mr. J. L. Fay, of the company, with which an ordinary lineman can sight over the object to be crossed and read directly on a scale the pole required to give 5-ft. clearance when set in the ground to the proper depth. The estimator is similar in optical principle to the mariner's device for reading star ascensions, although simplified and arranged with scale calibrated directly in pole heights. To use the estimator, the lineman measures with tape or by pacing a distance of 50 ft. from the point beneath the tree or obstacle, and then, from this distance, sights through the estimator tube at the tree-top or obstructing line. Turning a knurled thumbscrew at the side rotates a level until its bubble, seen in a 45-deg. mirror, appears alongside the center of the tube. After bubble and object have been sighted together in the tube, the pointer shows on the calibrated scale the exact height of the pole, including clearance and setting allowances. Twenty-five-foot poles are provided to be set 4.5 ft. in the ground, 45-ft. poles 6 ft., and 75-ft. poles 7.5 ft., with proportionate amounts for intermediate heights. The estimators as built for the Milwaukee company weigh only a few ounces and can be carried in the vest pocket.

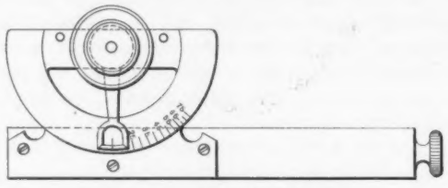
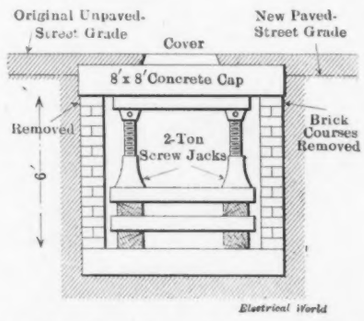


Fig. 2—Pole-Height Estimator.

ADAPTING MANHOLE TO NEW STREET GRADE.

It often happens that after manholes have been installed to the existing grade level in an unpaved street the grade is changed or lowered when the street is paved, necessitating the adaptation of the manhole top to the new level. In some places the practice has been to wreck the old concrete cap, constructing a new one to conform to the new conditions. This expense and trouble was recently avoided, however, by Mr. Richard Krohn, foreman of the Milwaukee company's underground department, who employed a couple of powerful jacks to lift off the concrete cap so that a course or two of bricks could be removed, after which the cap was dropped back into place in its new position. As shown in the sketch, the 8-ft. by 8-ft. by 7-in. concrete cap, weighing 2 tons, was handled by a pair of 2-ton screw jacks blocked up to the proper height. The internal height of the manhole, 6 ft., left ample room after subtracting the width of two courses of bricks. A similar scheme might also be used to raise the cap to a higher grade. Three men, at 20 cents per hour, made the change in cover position in three

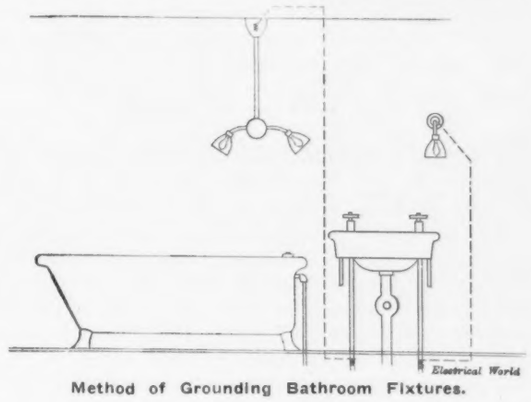


Adapting Manhole to New Street Grade.

hours. To have wrecked and rebuilt the concrete cover cap would have cost at least $30 for labor and materials, besides requiring several days' time.

GROUNDING OF BATHROOM FIXTURES, ETC.

All fixtures installed over or near damp grounds, earth floors, metal steps, radiators, bathtubs, wash-basins, etc., are now required by the Omaha city electrical inspection depart-



Method of Grounding Bathroom Fixtures.

ment to be securely grounded. City Electrician Michaelsen also recommends generally that porcelain receptacles be used in these places unless such sockets detract seriously from the appearance of the installation, in which case the porcelain proviso is waived. A number of mysterious deaths have occurred in various cities from apparently slight shocks given while the victim was making good contact with bathtub and pipe grounds. As a protection against any part of bathroom fixtures becoming charged this grounding ordinance is now being rigidly enforced in Omaha wherever fixtures, sockets, etc., are near enough to be reached or touched while making contact with grounded conductors.

RURAL TRANSMISSION LINE WITH IRON-CABLE CONDUCTORS.

A Nebraska operator whose system connects a number of small towns is building a 25-mile 22,000-volt transmission line, the conductors of which are 3/8-in. iron cable carried on 35-ft. poles set twenty to the mile. The problem of the rural transmission line, with its light loading, is chiefly one of mechanical strength rather than electrical carrying capacity, and since the conductivity of the iron cable is about one-sixth that of copper, this 3/8-in. conductor used will about equal No. 6 copper wire. Laid down along the right-of-way the material for this line is costing about $300 per mile, and it is estimated another $100 will be required for erection, making the total cost of construction $400 per mile. Data on the resistance, reactance, regulation, etc., of the 25-mile line will be available within sixty days, or as soon as the line has been put into service and tested.

INDORSEMENT OF CODE STANDARDS.

Official electricians in over fifty cities and towns of Colorado, Wyoming and New Mexico have issued bulletins requiring the exclusive use of 1911 National Electric Code specification rubber-covered wire, flexible cord, armored cable and fixture wire in all installations made on or after Nov. 1, 1912. This action accords with earlier recommendations of the Rocky Mountain Fire Underwriters' Association.

SOME REFLECTIONS ON INTERIOR-WIRING CONSTRUCTION.

Some of the paradoxes of interior electrical construction —unnoticed, perhaps, because so familiar—were pointed out by Mr. Waldemar Michaelsen, city electrician of Omaha, in an address before the Omaha Electric Club on Oct. 9.

"It is the weakest link that determines the strength of the chain, and all extra material in other links is, in a sense, wasted." This statement cannot be classed as a news item, said the speaker, except as applied to electrical construction work for inside wiring. Such work may be imagined as a chain with many links, whose main purpose is safety of life and property. It is important, therefore, that a good, sound and well-proportioned chain be provided, in which every link is sufficiently strong to carry its share, and without any being so strong as to bungle matters without accomplishing adequate results.

The 1911 code standard rubber-covered wire is a great improvement over the material it supersedes and will undoubtedly prove satisfactory to users as well as manufacturers. It is safe to say that this link of the chain is now heavy enough for all present and immediate future requirements.

The introduction of iron or steel conduit was a great step ahead. At first all conduit had to be heavily enameled, not so much for insulation as to protect against deterioration. Then, this method not proving altogether satisfactory under certain (rather rare) conditions, it was thought better to galvanize the conduit. Further activities led to sherardizing, and more recently to "hot" galvanized conduit. The real point aimed at, however, will probably never be reached, said the speaker, until all pipe is covered within and without with a heavy coating of pure gold. But even if this were really desirable for a few special locations, where fumes or acids exist, would such an expensive product be justified everywhere else? Plumbers and steam and gas-fitters have been contented for years with materials inferior to ours, which are used as conductors for liquids and gases under high temperatures and pressures. On the other hand, for electrical work these pipes serve only as a raceway through which to pull wires.

Connections to conduit fittings by means of bushings and lock-nuts the speaker believed to be poor practice, declaring them unworkmanlike, both electrically and mechanically. No connections on conduit should be made, he declared, except by screw-threads, even if a suitable fitting must be found to take the place of the steam-fitter's "union." Consider, too, for example, he urged, the use of tapered pipe-threads on conduit to be screwed into straight machine-threaded couplings. Do enameled boxes, fittings or cabinets make for preservation of electrical continuity in conduit systems?

But, while these points have been overlooked, other links in the chain, insisted Mr. Michaelsen, have been so neglected that they are almost past the danger line. One of these is the use of knife switches. Conductors throughout their entire run, no matter how inaccessible, are carefully insulated to prevent leakage and accidental contact. Knife switches, however, are generally placed where they may not only be touched but where they are intended to be handled, not by experts, but by people who know nothing about electricity. Here all protection and all insulation is removed, and opposite polarities are placed in close proximity, with its consequent dangers. The practice was bad enough in the old days, when circuits were religiously kept clear from grounds, but it is many times worse now when secondary circuits are either grounded or harbor the still greater danger of crosses with high-potential wires. Whether such switches should be insulated throughout, placed in self-closing boxes or entirely remodeled, the author offered to submit to the judgment of others, but this link, in his judgment, is very badly in need of "fixing."

The same reasoning, he said, applies to a great extent to lighting fixtures. These, meant to be handled by laymen, are the flimsiest parts of most installations. In the construction of fixtures the designer's dream seems always to be given the right-of-way over the electrician's necessities, and thought of safety is secondary.

Present practice in installing watt-hour meters is also worthy of consideration. The wires leading to and from the meter, even if out of reach, are carefully inclosed in conduit. But where they enter the meter, generally within easy reach from the floor, they are stripped of their armor and in unprotected and dangling loops are brought into and out of the case. Meters could easily be made so the conduit might directly enter the casing on both sides, avoiding the appearance of unfinished work and the test of the honesty of the consumer.

Power lines and connections to motors, after being carefully guarded throughout their entire run, are at the machine stripped of all protection, save the rubber insulation, and connected by coils or loops to the lead wires of the motor, often exposing bare terminals. Here more than any place else is where the wires are subject to interference by the floor sweeper and the motor attendant, and here is where they are left without protection against mechanical injury or accidental contacts. The old argument that this is necessary "in order to permit the motor to be shifted for belt-tightening" used to be partly correct, but the majority of motors installed nowadays are never moved at all. Those that are to be moved might have their conductors protected by flexible steel conduit. Motors could well be made with a connection box similar in detail to an ordinary outlet box, and fitted with covers permitting direct entrance of conduit or with bushings for open work. In such a box the leads from the motor should terminate, and within the box all joints between line wires and lead wires should be made by soldering, just as for all other outlets.

As a rule, nine wires are led into alternating-current compensators and starters for three-phase motors. Immediately above such starters there is generally located a fuse block for the running load. It is utterly impossible to make a mechanically finished and electrically safe job of these installations without inclosing the entire starter and fuse in a steel cabinet, which makes a very clumsy appearance. Better construction might result if these starters were required to contain the fuse in a box, made part of the starter housing, as was done on the old-time transformers which had a box with primary fuses at the top and one for secondary fuses at the bottom. It would then be possible to let one conduit enter this box for the three incoming wires and another for the three wires to the motor, while the last three connections would be made right in the box.

Again, in the case of starting rheostats and speed controllers for direct-current motors, one meets open and absolutely unprotected contacts within reach of operators and the public, and very often mounted above grounded floors. There is, as a rule, only about ½ in. between the position of safety on the handle and danger on the contact points. The face-plates of such rheostats generally carry three or more binding posts with screw connections, presenting an alluring temptation for meddling, as well as the unavoidable dangers of screw contacts. This construction evidently had its origin at the time when it was always a question whether a given starting box would be all right for this or that purpose. It also made provision for quick removal when the rheostat burned out. But all these conditions have changed long ago. Could not such starting boxes be made with all contacts on the back of the face-plate? It would be easy enough to see when they spark and need cleaning, as the sparking would readily show through the housing of the rheostat. It would also be easy to clean the contacts if the face plate were mounted with hinges so that it might be opened for inspection and repairs. As for the binding posts, the author recommended that they be entirely eliminated and the terminals connected to the line wires by soldered joints in an outlet box, as described for motors.

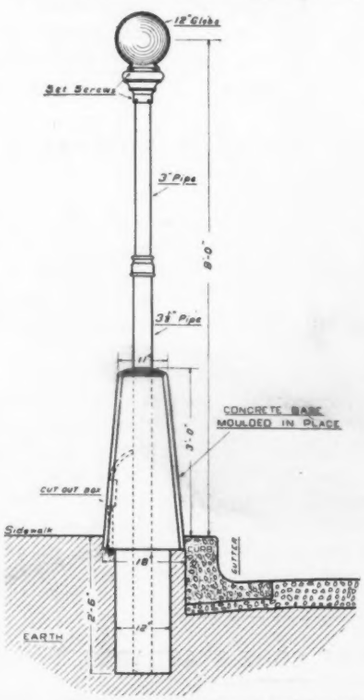
In conclusion, said Mr. Michaelsen, there is no excuse for the electrical profession to provide an over-measure of safety in certain parts of installations and permit absolute danger to exist elsewhere. By construction of the kind outlined above, he declared that all interests would be better served. The consumer and user would secure safety and less deterioration; the manufacturers and contractors could produce installations they could be proud of, and inspectors would neither need to be ashamed to pass such work nor live in constant fear of a penitentiary term for approving work which any man with ever so little experience should see, and ought to know, is dangerous.

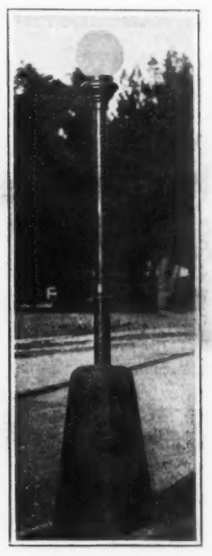
STREET LIGHTING IN ALAMEDA, CAL.

The street-lighting problem in Alameda, Cal., has apparently been solved in a very satisfactory manner, as to costs of installation, maintenance and service. Alameda is a suburban residence city on the east side of San Francisco Bay, south of Oakland, and is particularly noted for the abundance of beautiful trees along its streets and boulevards, which, as in many Western cities of 30,000 population, are well paved, even in the more thinly settled portions.

Street-lighting experience in Alameda commenced with arc lamps grouped on a few high towers. Later series direct-current arc lamps at rather infrequent intervals on street corners were installed, these being in turn replaced by alternating-current arc lamps supplemented by some series incandescent carbon-filament lamps. Owing to the dense and ever-green foliage very little of the light was effective on the streets.

The advent of the tungsten lamp seemed to offer an opportunity for providing efficient lamps below the foliage and at the same time a good distribution of light. As property values are comparatively low, averaging from $30 to $100 per front foot, the question of cost was an important feature. It was evidently impracticable to run overhead wires to feed energy to electroliers of ordinary height, and the





Figs. 1 and 2—Standard Adopted at Alameda, Cal.

cost of underground wiring appeared at first sight to be prohibitive.

Considerable experimenting was done to obtain a base and system of wiring best adapted to meet the conditions, and in the Alameda post, which, though not particularly ornamental, is pleasing in appearance, the necessary massiveness and rigidity are obtained by means of a concrete base with

Fig. 3—Typical Street View at Alameda, Cal.

an upper portion consisting of two sizes of ordinary gas-pipe with a cast-iron globe holder, located 8 ft. above the curb. The city ordinance requires trees to be trimmed 9 ft.

AVERAGE COST OF LIGHTING INSTALLATION IN ALAMEDA.

Material.	Cost per Post.	Cost per Assessed Foot.
Lamp-post	$11.7700	$0.0873
Conduit	6.4560	0.0473
Junction boxes	0.2124	0.0016
No. 10 duplex wire	3.6610	0.0301
Extras	0.9149	0.0068
Labor	4.7561	0.0353
	$27.7704	$0.2084

above the curb, and this height permits the unobstructed lighting of the road surface and sidewalks. The posts are placed about 75 ft. apart on opposite sides of the streets, making the spacing on each side 150 ft. At the intersection of streets a post is placed on each diagonal corner.

Use is made of ordinary 110-volt, 60-watt tungsten lamps operated in parallel and fed with energy from a pole transformer connected to a special 2300-volt, constant-potential street-lighting circuit. Each transformer supplies energy for the lamps on two and a half blocks of streets each way. The 110-volt circuit is carried down the pole and distribution to the lamp-posts is made under ground with ordinary galvanized-iron conduit buried a few inches below the sod in the parking between the curb and the sidewalk. A cast-iron outlet box with cover is embedded in the concrete base of each pole to facilitate the drawing in of wires, and this houses a double-pole fuse block. The lamp is protected by a 12-in. opalescent globe and all exposed metal and cement surfaces are painted dark green.

Perhaps the most interesting feature in connection with the installation is its low cost and the satisfactory life of standard 110-volt tungsten lamps when carried on a post of this construction, which, owing to the heavy cement base, is particularly free from vibration.

The money required for the installation was provided by district assessment, based upon street improvement. The assessment charges were 25 cents per front foot of property. The actual cost has been somewhat less than this and it is probable that a small refund will be made. There are at present some 3000 electroliers installed and there will be about 4000 when the work of lighting the entire city is completed.

The average cost of the first six districts, including 1952 lamp-posts, with an assessed street frontage of 263,507 ft., is shown in the table in the first column of this page.

Owing to the location of two lamps at intersecting street corners, the average distance for electroliers between lamps on one side of the street is about 135 ft.

ITEMIZED COST OF ALAMEDA POSTS.

JUNCTION BOX.

Casting	$0.30	Bushings	$0.084
Drilling and tapping	0.05	Screws	0.016
Gasket	0.03	Compound	0.02

CONDUIT PER FOOT.

Conduit, ¾ in.	$0.0493	Dipping	$0.0024

LAMP-POST.

Cast-iron top	$1.00	Socket	$0.08
Cast-iron box	0.30	Cut-out	0.11
Pipe, 7 ft. of 3.5 in.	1.66	Fuse plugs	0.06
Pipe, 4 ft. of 3 in.	0.72	Screws	0.04
Nipple, ¾ in. by 3 in.	0.02	Bushings	0.06
Reducer, 3.5 in. by 3 in.	0.46	Wire, No. 10 duplex	0.29
Concrete base	3.75	Labor	0.36
Globe, 12 in. by 6 in.	1.00	Painting	0.25
Tungsten lamp, 60-watt	.56		

EXTRAS.

Condulets	Paste	Paint	Globes
Solder	Brushes	Lamps	Nipples
Gasoline	Screws	Couplings	Oil
Caps	Straps	Tape	Fuses

Depreciation of Tools

This appears to be a remarkably low cost for an electrolier system with underground wiring.

Exception may be taken to the character of conduit and to the method used for the underground distribution from the pole transformer to the electroliers, but, as some of this work has been in use for more than two years and has given no trouble whatever, there does not appear to be any justification for a more expensive system of conduit, at least where similar climatic and other conditions prevail. The accompanying illustrations show fully the details of construction and the general appearance of the electrolier as used in Alameda. The consulting engineer for the entire installation was Mr. Wynn Meredith, of the firm of Sanderson & Porter, San Francisco, Cal.

RE-WIRING POWER PLANT, CAR BARN AND AUXILIARY BUILDINGS.

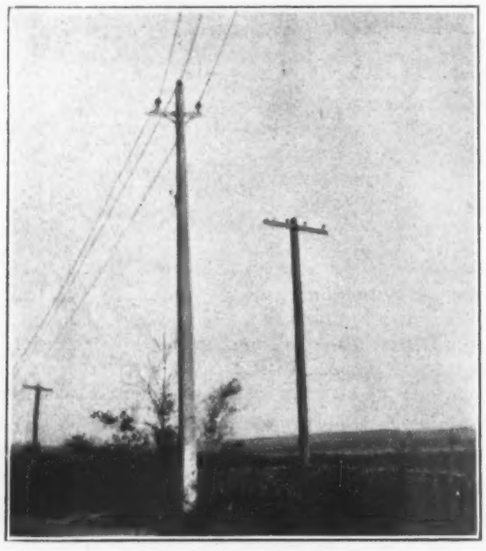
At Pueblo, Col., the Arkansas Valley Railway, Light & Power Company, controlled by H. M. Byllesby & Company, of Chicago, has recently completed the re-wiring of all lighting and motor circuits in its power plant, car barn and auxiliary buildings, the main features of which are described in what follows:

All wiring in the engine room and basement, auxiliary room, office, transformer substation, machine shop, blacksmith shop, storeroom, laboratory building and paint shop is in conduit, with condulet fittings and steel cut-out cabinets. The wiring in the boiler house was installed with slow-burning insulated wire, carried in iron conduit suspended a few feet from the boilers, at front and rear, with condulet receptacles and locked guards. In the engine room the arc lamps formerly used have been replaced with three-lamp brackets, each outlet containing a 100-watt tungsten filament lamp. The car barn is equipped with sprinklers, and standard knob construction is employed except in the pits and on the side walls, where conduit is utilized. All station transformers for the synchronous converters and oil-immersed reactances are located in separate compartments.

with 8-in. brick containing walls and reinforced concrete ceiling slabs, having ventilation to the outside of the building, sewer drain connection, standard automatic fire doors and concrete raised sills. All station wiring for 2300 volts or less is also in conduit, except the immediate connections to the switchboard buses. The total cost of these improvements was about $12,000.

KANSAS CONCRETE-POLE TRANSMISSION LINE.

The 800-kw water-power plant of the Rocky Ford Power Company is connected to the Manhattan (Kan.) Ice, Light & Power Company's plant by a 6-mile transmission line using concrete poles. These 35-ft. structures are rectangular in section, with 45-deg. corners to prevent cracking, and measure 15 in. at the base and 7 in. at the top. They are set at 260-ft. intervals. The solid concrete is reinforced by four ¾-in. steel rods. Four-by-four-inch galvanized



35-ft. Concrete Pole; Steel-Angle Cross-Arms.

3/16-in. angle-arms are used, carrying cast-iron pins through-bolted in place. The braces are formed of single, specially bent angles of smaller section. Built in a central yard after some experimentation, these 120 poles cost $22 each. They were hauled to their sites and erected with gin poles at a cost of $5 additional per pole, considerable unforeseen difficulty having been experienced in transporting the heavy structures through the soft marsh land which the line traverses. After three years' service the line gives every evidence of complete durability and satisfaction.

INCREASING POWER REQUIREMENTS OF MOVING-PICTURE ARCS.

Managers of moving-picture shows are beginning to accede to the public's demands for at least a "twilight" quality of illumination in the room during presentation of the films, so that persons coming in late can find seats without groping their way in the Stygean darkness which formerly prevailed. Several cities have, indeed, made this the subject of ordinances, chiefly for reasons of moral protection to the young people who frequent the exhibitions. Milwaukee, for example, has a law fixing the minimum lamp wattage per square foot of floor area to be kept burning during exhibitions. In other places attentive managers have observed and profited by the fact that the most popular show houses are those which are best lighted during the pictures.

This higher illumination in the auditorium has called for rapidly increasing powers of the projecting arcs, in order to produce good "contrasty" pictures. A manufacturer of 60-cycle rotary converters for supplying direct-current to picture machines lately reports being forced to bring out new ratings of much larger ampere rating than the original stock built under the requirements of even a year ago. A 30-amp direct-current arc used to be considered of good size, but machines are now in use employing 1-in. carbon electrodes and demanding 65 amp. The next step seems likely to be 100-amp lamps for the larger houses. Direct current, of course, provides a better and more efficient arc, but the fact that four-fifths of the central stations in this country distribute only alternating current makes some form of converter apparatus necessary.

In another direction the central-station man, who is often the sole local exponent of good-lighting principles, can do much to conserve the eyesight and comfort of his community by urging nickel-show managers to remove or shield all lamp filaments from the vision of the audience. All too frequently the visitor finds low side-lamps with reflectors pointed directly at the chairs, exposed orchestra or piano-score fixtures, or even some such surface as a clock-face or program sign with unnecessarily high illumination, the intensity of which, compared with the picture, forms an annoying source of glare all during the performance.

Letter to the Editors

WOOD PRESERVATION.

To the Editors of the Electrical World:

Sirs:—In view of the discussion nowadays regarding the preservation of wooden poles, it is believed that an outline of the method adopted by the Tyler (Tex.) City Light & Railway Company should prove of interest.

When the building of the street-car system in Tyler was undertaken the agents of several wood-preserving companies put in an appearance, each one claiming to have not only the best but the surest way of saving the pole. After making a very careful study of the matter, together with the character of the soil, the writer arrived at the conclusion that to treat a pole with the preservers that are on the market to-day would not be best, for the following reason: Dipping or painting the butt of a pole with asphaltum preparations not only prevents the moisture from getting in the pole but also forms a hard coating or shell on all the pole surface below the ground, which tends to hold any moisture that may get into the pole over the top of the shell. The moisture thus confined has every chance to carry on the rotting and decaying process undisturbed. In order to eliminate this trouble, the Tyler City Light & Railway Company treats or paints its poles to about 6 in. above the ground with a heavy oil such as is used on railway curves. This oil is very high in asphalt content and creates a greasy condition of the fibers at the butt end of the pole. It is believed that they will remain greasy for several years and that no moisture can enter the pole. Hence the pole will not be rotted from that cause. From the ground up the poles are painted with white lead mixed in high-grade oil. This is made high in oil for the first coat, and the entire surface is covered with it. For the second coat the poles are covered 7 ft. above the ground with black graphite paint, and from this line to the top they receive a second coat of high-grade white-lead paint.

Tyler, Tex. William C. Thayer.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Single-Phase Induction Motors.—R. MOSER.—The first part of a mathematical paper on the theory of the single-phase induction motor. There are two usual theories, one based on the resolution of the single-phase alternating flux into two rotary fluxes revolving in opposite directions and the other, the "cross-flux theory," based on the fact that the voltages induced in the rotor windings can be resolved into two components with special properties. The author endeavors to give a theory of the single-phase induction motor without making use of any auxiliary conceptions. In the present instalment he gives formulas for single-phase stator windings, the stator emf, the application of stray-flux coefficients to single-phase machines, the current of a single-phase motor when loaded and the emf induced by a single-phase flux in a rotating winding.—*Elek. u. Masch.* (Vienna), Oct. 13, 1912.

Three-Phase Commutator Motors.—M. SCHENKEL.—The conclusion of the English translation of his recent German paper on the Siemens-Schuckert three-phase commutator motor. After a discussion, with the aid of diagrams, of the operation of a three-phase series motor with a single set of brushes he takes up the discussion of the operation with a double set of brushes, as used by the Siemens-Schuckert company. These motors are now used for pumps and fans, in textile factories and for mine hoists, and are also to be applied to rolling-mill work.—London *Electrician,* Oct. 11, 1912.

Braking Polyphase Series Commutator Motors.—F. NIETHAMMER AND E. SIEGEL.—An illustrated mathematical article in which the author shows that it is possible to brake the polyphase series commutator motor in such a way as to return energy into the network so that it behaves almost exactly like a single-phase repulsion motor. In order to suppress the self-excitation "braking resistances" are inserted in the different phases. These may be the smaller the higher the magnetic reluctance offered to the rotor flux in the motor (for instance, due to the use of high iron induction and large air-gaps) or the higher the magnetic reluctance of the transformers which are connected to the motor.—*Elek. u. Masch.* (Vienna), Sept. 29, 1912.

Converter.—J. H. JACOBSEN.—An illustated article on the "auto-converter C. M. B." of MacFarlane and Burge, which transforms the voltage of a direct-current distribution system to any voltage between zero and double the voltage of supply. The author discusses the practical uses of this machine, which is being introduced in France. The characteristic features of this converter are that it has only one armature winding and a single commutator and that the magnetic circuit is independent of the cast frame of the machine. For this reason it is much lighter and smaller than motor-generators of the same capacity. The arrangement of the windings is carried out in two different ways according to whether the secondary is to furnish a constant voltage or a constant current. The author gives the characteristic curves of two such machines, one being for supply of arc lamps without resistances and the other for the purpose of electric welding.—*La Lumière Elec.,* Oct. 5, 1912.

Reactance Voltage.—J. LISKA.—An article on the calculation and experimental determination of the "mean reactance voltage" in direct-current machines. The results of the various experiments show that Arnold's method of calculating the mean reactance voltage and the commutation poles gives results which are sufficiently accurate for practical use.—*Elek. u. Masch.* (Vienna), Oct. 6, 1912.

Lamps and Lighting.

Arc-Lamp Feeding Mechanism.—A note on a recent British patent (No. 1755, Oct. 3, 1912) of F. Steinhert. A ratchet gear exerts alternately a supporting and a releasing action on the electrodes. The electrodes are inclined, one having teeth formed on it. The feeding gear takes the form of a reciprocating double pawl engaging with its upper end beneath one of the teeth of the electrode, and by pivoting outward is removed from the tooth so that the carbon falls one tooth, while its other end, resting against the lowest tooth, is drawn nearer to the electrode. Alternatively, the feeding gear may consist of a clock-work-driven spindle on which is a worm parallel to the electrode engaging a rotary support beneath one of the teeth. The gear is controlled by a brake, which bears against the lower end of the electrode until the lowest tooth is burned away so much as to permit it to lose its support.—London *Elec. Eng'ing,* Oct. 10, 1912.

Fittings for Metallic-Filament Lamps.—L. BLOCH.—The author describes various special reflectors and fittings for interior lighting with metallic-filament lamps.—*Elek. u. Masch.* (Vienna), Oct. 13, 1912.

Generation, Transmission and Distribution.

Water-Power Plant in Brazil.—F. FREDERICK.—Santos, in the republic of Brazil, is one of the great coffee-shipping ports of the world and for the development of its waterfront has required an elaborate system of quays. These have been developed by the Santos Dock Company, which holds a concession for the whole waterfront. The company, needing electric power for its own use, has developed an electric distribution system deriving its power from a point about 30 miles from the city, where a small stream plunges down the seacoast from the mountain range that runs beside it. Eventually 100,000 hp can be obtained from this source, but the present capacity of the plant is only 15,000 kva. The system and the equipment exhibit no radical departures from current American practice.—*Gen. Elec. Review,* October, 1912.

Traction.

Single-Phase Traction in Norway.—F. MARGUERRE.—The first part of an illustrated paper on the Rjukanfos single-phase railway in Norway. The present instalment gives a general outline of the conditions of the road and of the reasons which led to the choice of the electric system.—*La Lumière Elec.,* Sept. 28, 1912.

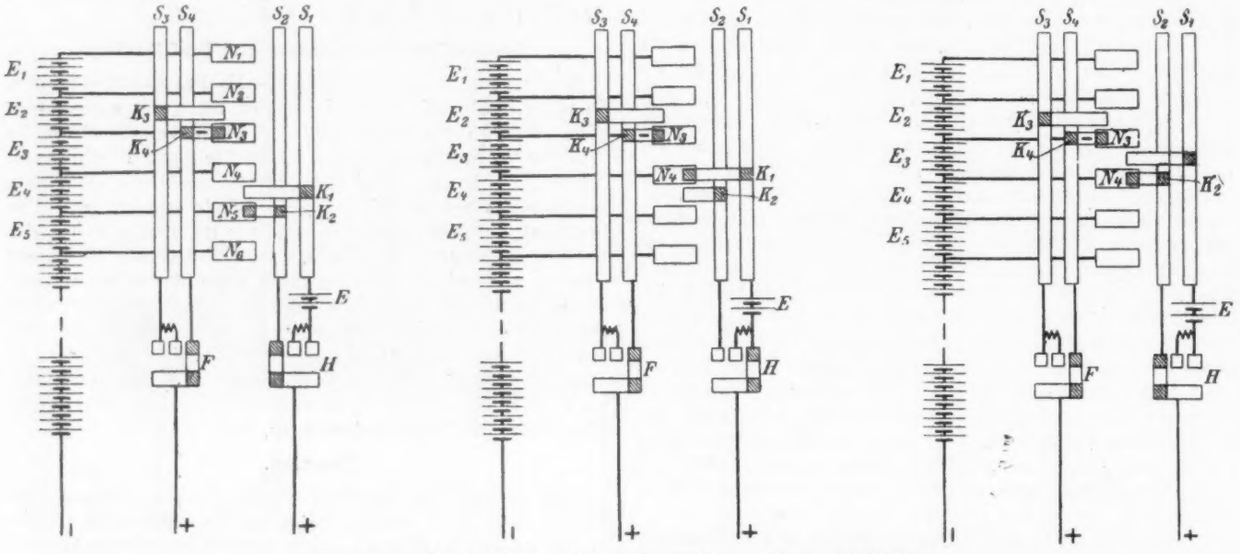
Installations, Systems and Appliances.

High-Tension Substation Design.—C. M. RHOADES.—An article illustrated by numerous diagrams in which the author gives some comparative designs for a particular problem in high-tension substation design with reference to the advantages of outdoor, semi-outdoor and indoor stations. As is pointed out in a separate editorial by A. H. Kruesi, the results of this study do not show any marked advantage for the outdoor design, although this advantage may become more marked as apparatus becomes more highly developed and lower in cost. All investigations so far point to the fact that for stations of importance and considerable size the advantage of the outdoor construction is very small. Its field for some time to come will probably be limited to small transformer stations and transfer or switching stations. As a general rule, the semi-outdoor type represents the preferable practice as compared with the outdoor type, and its advantages over the outdoor construction warrant its present use.—*Gen. Elec. Review,* October, 1912.

Glasgow.—An abstract of the financial report of the

municipal electric station in Glasgow for 1911-12. The total output was 44,492,630 kw-hr. sold. Over 16,000,000 kw-hr. were for private lighting, and of these 8,244,166 were sold at 7 cents, 1,839,004 at 6 cents, 389,872 at 4 cents, 1,625,411 at 3 cents, 193 at 2 cents and 4,195,999 at 1.5 cents. Over 26,000,000 kw-hr. were sold for private power and 415,000 for heating and cooking to domestic consumers. The motor-service and heating supply was sold as follows: 6,416,416 kw-hr. at 3 cents, 2,033,586 at 2 cents, 8,296,422 at 1.5 cents and 9,680,280 at 1 cent. During the last year the scheme whereby domestic consumers can obtain a supply of energy for cooking, heating, etc., at 2 cents per kw-hr. without separate wiring has continued to give favorable results, the number of consumers now taking advantage of this scheme, which was started only in October, 1910, being 560. During the last year 3.258 lb. of coal was consumed per kilowatt-hour generated, compared with 3.478 the year before. This represents a total yearly saving equivalent to 5200 tons. The use that has been made in the generating stations of recording water meters and other apparatus for insuring efficient and economical combustion of fuel has largely contributed to this result. The total connected load amounted to 61,097 kw.—London *Electrician*, Oct. 11, 1912.

Storage Battery Switch.—C. Kjär.—The author first compares the voltage regulation of storage batteries in lighting systems by means of special switches with accessory storage cells and regulation by means of boosters, favoring the former method. In order to reduce the rather high cost of the switch installation for large batteries it is important to reduce the number of switch connections. In order to reduce them to one-half of the number in the original arrangement each switch group (number of cells between the switch contacts) is doubled, but in order to enable one to get the same exactness of regulation a special group of cells (the auxiliary cells), which has one-half as many cells as a regular switch group, is periodically connected to the system. This is done by the battery switch. The author first describes the pioneer system of Erlacher and Besso and a later system of the Siemens-Schuckert company. He finally describes two new systems which have various practical advantages. The special feature of the first is that the auxiliary cells are used exclusively as polarization cells (being connected in opposition). In Fig. 1, which shows the first position, E_1, E_2, E_3, E_4, E_5, are the battery groups and E the auxiliary cells. In the position of Fig. 1 the auxiliary cells E are not active. If it is intended to raise the voltage the brushes K_1 and K_2 are moved upward by half a step on the graduated scale so as to reach the position in Fig. 2, while simultaneously and automatically the auxiliary cell switch H is turned to the right. In this way the battery group E_4, which consists of four cells, has been added, but at the same time the two auxiliary cells E have been connected in opposition so that the voltage has been raised only by the emf of two cells. In order to increase the voltage still further the brushes K_1 and K_2 are again moved one-half part of the graduated scale, whereby at the same time the auxiliary cell switch H is returned into its original position, as shown in Fig. 3. Now, the two auxiliary cells which were in opposition have been disconnected and the voltage has been increased again by that of two cells. In this way the auxiliary cells are never discharged; they do not need to have any capacity, and their electrodes may consist of simple lead plates. A further modification of this method is also described.—*Elec. Zeit.*, Oct. 10, 1912.



Figs. 1, 2 and 3—Method of Voltage Regulation of Storage Batteries.

Wires, Wiring and Conduits.

Calculating Networks.—H. Frohmann.—A mathematical article describing various practical applications of the following principles: The calculation of a network may be based on the determination of the balancing currents. These balancing currents are caused by the differences in the voltage drops to different points of the network, due to the loads of the consumers. With respect to the balancing currents, a loaded network with feeding points of equal potential may be replaced by an unloaded network of the same configuration with feeding points of fixed unequal potentials, since the production of the balancing currents is determined solely by the voltage differences, no matter how they are caused. It is shown that this principle greatly simplifies various calculations.—*Elek. u. Masch.* (Vienna), Sept. 29, 1912.

Duralumin.—Duralumin is an aluminum alloy containing 90 per cent aluminum. The author gives various details as to its mechanical properties and resistance against chemical influences. He then discusses the application of duralumin to electric line construction.—*Elek. u. Masch.* (Vienna), Sept. 29 and Oct. 6, 1912.

Electrochemistry and Batteries.

Theory of Relativity.—R. D. Carmichael.—A theoretical paper giving a careful analysis of the postulates of the theory of relativity. The object is to establish some of the most fundamental and most readily accessible conclusions of the theory on the smallest possible foundation from the postulates.—*Phys. Review*, September, 1912.

Effect of Vibration on the Resistance of Metals.—H. L. BRAKEL.—The effect of tension, torsion and hydrostatic pressure on the resistance of metals has been the subject of numerous investigations. The work of the present author is a study of the effect of vibration on the resistance of metals. For this purpose a method was derived by which metals, in the form of wires, could be vibrated with a constant amplitude. This method also permits the amplitude to change through a wide range. The method is described in detail and the results obtained with different kinds of wires are given in form of diagrams. One of the interesting results is that in all cases the change in resistance due to vibrations could be removed by annealing the wires at bright red heat.—*Phys. Rev.*, September, 1912.

Reflection of Beta Rays by Thin Metal Plates.—W. B. HUFF.—An account of an experimental investigation, the results of which are as follows: The thinnest obtainable metal plate may reflect a measurable amount of the incident beta radiation. As measured by its ionization in a small chamber, the increase of reflected beta radiation is initially closely proportional to the thickness of reflector. The quality of the reflected beta radiation is dependent on thickness of reflector. The particles reflected from a thin reflector are absorbed linearly by thin sheets of a metal of low atomic weight. The absorption appears to approach linearity when both reflector and absorber are of high atomic weight but extremely thin. The difference in quality shown by beta radiation from thin and from thick reflectors of the same metal may be regarded as evidence of loss of speed due to passing through matter.—*Phys. Review*, September, 1912.

Units, Measurements and Instruments.

International Electrotechnical Commission.—C. LE MAISTRE.—A portrait of all the members of the International Electrotechnical Commission and an account of the work which has been done so far and the results accomplished.—*Elek. Zeit.*, Oct. 10, 1912.

Frog-Muscle Recorder for Electric Waves.—An illustrated description of an arrangement used by Lefeuvre in Rennes for recording the relay signals emitted from the wireless telegraph station of the Eiffel Tower. In Fig. 4 *A* is the antenna, *T* the earth, *E* a battery of three cells connected to a potentiometer *P*. In *R* there are two telephone receivers, one connected to the potentiometer *P* and the other to the electrolytic detector *D*. Finally *M* is a frog

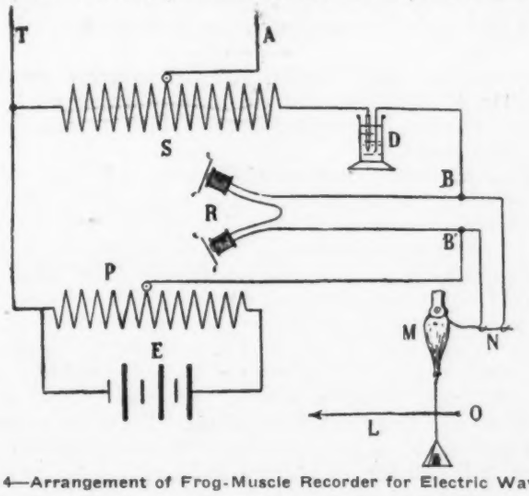


Fig. 4—Arrangement of Frog-Muscle Recorder for Electric Waves.

muscle which operates a recording lever *L*, the metallic wire *N* making connection to the two terminals of the double telephone receiver *R*. Under these conditions the excitation of the frog muscle is produced by the self-induction currents in the telephone coils. The method of recording is very exact. Examples of records are reproduced.—*La Revue Elec.*, Sept. 13, 1912.

Alternating Load Tests.—B. P. HAIGH.—A British Association paper in which the author describes a machine for testing materials under repeated stress. Use is made of an alternating magnetic flux applied to a wire specimen. The lower end of the specimen, *W*, is attached to the armature *A* (Fig. 5). This is a laminated block of iron, supported on flat springs giving freedom for vertical motion in a

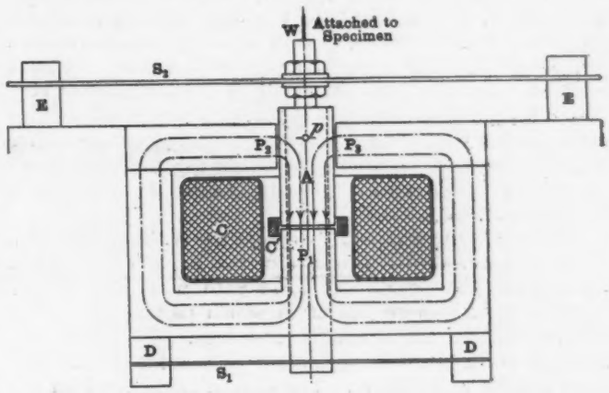


Fig. 5—Device for Testing Material Under Repeated Stress.

small range, directly over the pole P_1 of the magnet. A magnetic flux (indicated by chain lines) is produced by the large coil *C*, and passes across from the armature to the main pole P_1, then back to the subsidiary poles P_2 and P_3 by means of the laminated yoke. The total air-gap in the circuit is made small, so that a coil of moderate size is sufficient to produce a very strong flux in the air-gap, thereby developing a strong pull between the pole-face and the armature. The magnetic pull is therefore proportional to the square of the ratio of volts to cycles, a relation which holds good so long as a constant proportion of the total magnetic flux passes across the gap—that is, so long as the leakage flux which passes between the sides of the armature and the pole P_1 is a constant proportion of the whole. The precautions necessary to insure this are discussed. The method of standardizing the machine consists essentially in determining the mean value of the pull of the magnet. When this is known, together with the wave-shape of the magnetic flux, the maximum value of the pull is readily deduced.—London *Electrician*, Oct. 4, 1912.

Instrument to Measure Capacity and Self-Induction.—A note on a recent British patent (No. 7657, Oct. 3, 1912) of W. P. Thompson. The instrument consists of two systems and is quite independent of frequency. The movable parts are coupled together and have no other controlling force. One is an electrometer and the other is also an electrometer or else a dynamometer. Each is connected to two different fixed or adjustable impedances traversed by the same current. Each system has a different law connecting torque with angular displacement, so that the ratio between the effective potential differences impressed on the two systems may be measured.—London *Elec. Eng'ing*, Oct. 10, 1912.

Improvement of the Efficiency of Microphones.—A note stating that Petersen has improved the efficiency of telephonic transmission by heating the transmitter so as to dilute the air in it. In the Danish experimental station Hannover has confirmed experimentally the effectiveness of this method. It is added that the idea is not new, since more than ten years ago in Paris Germain built telephones which could be heated and by means of which a very effective transmission was obtained.—*Elek. Zeit.*, Oct. 10, 1912.

Telegraphy, Telephony and Signals.

Wireless Telegraph on Board Ship.—H. THURN.—The first part of a statistical article on the use of wireless telegraphy on board the merchant marines of the different

countries. The total number of commercial wireless-telegraph stations in the world is now about 3000, of which 2500 are on board ship. In the year 1911 the German wireless telegraph stations on land received and transmitted 13,206 wireless telegrams. The English public stations on land transmitted 5640 telegrams to ships and received from ships 34,161 telegrams. The German steamers transmitted in 1911 on about 780 trips 127,000 wireless telegrams; that is, 163 telegrams per trip. A single steamer on its trip from Hamburg to New York and return received and transmitted 526 telegrams with 6664 words. To send wireless telegrams from shipboard to the land is now very popular, but much less use is made of the possibility of transmitting telegrams from land to ship. The author begins to discuss the technical details of the wireless stations in commercial operation. The article is to be concluded.—*Elek. Zeit.*, Oct. 3, 1912.

Condensers for Wireless Telegraphy.—W. Torikata and E. Yokoyama.—After a brief illustrated description of the Saiki glass plate condenser filled with wax, the authors describe their own condenser in which part or all of the surface of the condenser is enameled. The dielectric strength of the enamel compound is high and it is quite free from trouble by moisture. The enamel sticks hard on the surface of the condenser and is quite elastic, so that it does not split. There are various kinds of enamel compound, and its composition has a great effect on the efficiency of the condenser. From their tests of the efficiency of various types of condensers the authors deduce the following general conclusions: The surface as well as the edges of the metal coating of the condensers must be very smooth; the smoothness is far more important than the nature of the metal itself in decreasing the total losses of the condenser; the total length of the edges of the metal coating must be as short as possible (from this point of view it is concluded that the Leyden jar type of condenser is better than the plate type); the enamel process is very efficient and practically annuls brush discharges; also it shows no difference between the various types of condensers in regard to brush discharge.—London *Electrician*, Oct. 4, 1912.

Propagation of Wireless Telegraph Waves.—W. H. Eccles.—A British Association paper on certain phenomena accompanying the propagation of electric waves over the surface of the globe. This paper describes some of the outstanding phenomena encountered in the transmission of electric waves, artificial and natural, over great distances, and shows how far they may be explained on the hypothesis of refraction or reflection of electric waves by masses of ionized air.—London *Electrician*, Sept. 27, 1912.

Miscellaneous.

Training of Electrical Engineers.—W. Reichel.—The conclusion of his long paper read before the German Association of Electrical Engineers. An electrical engineer should be trained in three directions—first, in the theoretical foundations of electrical engineering; second, in the design and construction of electrical machines, and, third, in the design and operation of electrical power plants and railways. But besides his specifically electrical training he should not neglect in any way the study of general mechanical engineering. The author thinks that the number of hours of training in electrical engineering compared to the hours of training in general mechanical engineering should have the ratio of 83 to 87 or about unity.—*Elek. Zeit.*, Oct. 10, 1912.

Mica Insulation.—A. P. M. Fleming and R. Johnson.—An article on the use of mica in the insulation of electrical apparatus. The authors first give the different properties of mica and give an outline of different forms of commercial mica products, dealing in greater detail with the use of mica for commutator insulation and for other insulating purposes in electrical engineering.—London *Elec. Review*, Sept. 20 and 27, 1912.

Book Reviews

The Electric Circuit. By V. Karapetoff. New York: McGraw-Hill Book Company. 218 pages, 55 illus. Price, $2. Second and enlarged edition.

A very practical text-book of electric circuit laws and phenomena for the use of electrical engineering students. The treatment combines graphic with analytic methods and reveals considerable originality. Complex quantities are applied forcefully to the discussion of alternating-current phenomena. A considerable number of practical problems are appended, with their answers, to each group of propositions. The book contains eighteen chapters. The first three relate to the direct-current circuit, the next four to alternating-current circuits. Nos. 8 and 9 relate to complex quantities. No. 10 deals with polyphase systems. The transformer is dealt with in No. 11. Then follow discussions of the induction motor, the dielectric circuit, single-phase cables and transmission lines. The book will be very useful to classes of electrical engineering students in technical colleges and also to the individual student of alternating currents.

Engineering as a Vocation. By Ernest McCullough. New York: David Williams Company. 201 pages, 4 illus. Price, $1.

A very entertaining book written by an engineer for would-be engineers. The style is genial and free as the air of the Western plains. The principles laid down are sound and earnest. The deductions drawn are those from experience and from an intimate acquaintance with engineering men. The great generalization to be drawn from existence is that no land, climate, occupation or mode of life has all the advantages and none of the disadvantages in the list of qualities. Otherwise that favored climate and occupation would receive all the prospectors. Each profession has its advantages and its drawbacks. If he be a candidate for the presidency of the United States a man must expect occasionally to be shot at. Consequently no man should select a profession unless he feels distinctly drawn toward it for its interest to him or his abilities in it. Engineering is a profession that is capable of richly rewarding the young man who with health, energy and perseverance has talents for directing men and applying mathematics. It is capable of ill-treating less favored rivals. The book tells the story in no uncertain manner.

Berechnung von Wechselstrom-Fernleitungen. By Dr. C. Breitfeld. Braunschweig, Germany: Verlag von Friedr. Vieweg & Sohn. 89 pages, 15 illus. Price, 4.60 marks.

This interesting and carefully prepared little volume bears nearly the same title as a book on long-distance alternating-current conduction by Dr. G. Roessler published in 1905. It forms, in fact, a sequel to that book and maintains a close relation thereto. Dr. Roessler's method of dealing with long alternating-current lines was thorough and elaborate, but was difficult to follow and employed complicated formulas. Dr. Breitfeld, in the present volume, has simplified the work considerably and has made it more accessible to the general reader by approximating more closely to hyperbolic methods. Nevertheless, valuable and helpful as is the treatment Dr. Breitfeld here presents, it is still far too obscure and involved, by comparison with the modern method of treating alternating-current lines by hyperbolic functions. One has only to compare the formulas of Roessler, as simplified by Breitfeld, with hyperbolic formulas to see the great economy of time and labor which the latter provide. The book will be of great service to all students of alternating-current engineering, as offering a useful contrast between the lengthy exponential and the brief hyperbolic mode of analysis.

New Apparatus and Appliances

ELECTRIC TOWER WAGON.

An electric tower wagon for emergency and repair work on its overhead trolley system has recently been purchased by the Nashville Railway & Light Company, Nashville, Tenn. This truck, which is capable of an average speed of 18 miles an hour, will replace two horse-drawn emergency wagons, and it is said that it will effect a substantial saving in the operation of the line department. Since tower wagons must always be kept in readiness for emergencies, it has hitherto been necessary to have an equipment of horses available for immediate action both day and night. The new electric truck, of course, obviates this, as it is always ready for instant service.

The truck is being supplied by the General Motors Truck Company, Pontiac, Mich. It is reported that the Nashville Company expects to replace all of its horse-drawn vehicles with electric tower wagons and will purchase two more electric trucks for the line construction department in the near future. The manufacturers report that electric trucks are being adopted in large numbers by public-utility companies for use in city and suburban zones.

Electric Tower Wagon.

ELECTRIC SPOT WELDER.

Several newly designed models of electric welding machines have been placed on the market by the Toledo Electric Welder Company, of Cincinnati, Ohio. As shown in the illustrations, special attention has been given in the new models to the problem of handling work conveniently from the mechanical viewpoint. Fig. 1 illustrates the company's No. 150 stove welder, and Fig. 2 shows the No. 124 automatic welder for lighter service. Both machines operate on the principle that in "spot" welding pieces of sheet steel can be fused together between the points of two water-cooled dies carrying a current of high amperage, requiring only a fraction of a second where the stock is light. The stock offers so much resistance at the points of contact with the dies that its temperature rises to the melting point practically as soon as the switch is closed, and a slight pressure on a lever handle forces the molecules of molten metal together in a permanent weld without more than a nominal rise in temperature in the stock surrounding the points of contact.

The new stove welder occupies a floor space of only 25 in. by 29 in., the height to the center of the dies being 42 in. The machine is provided with a ball-bearing table which

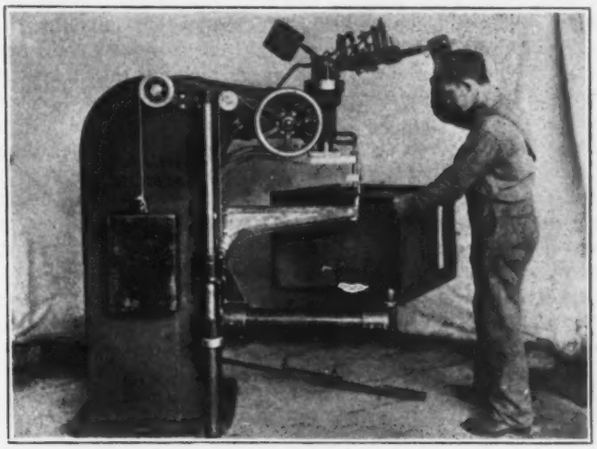


Fig. 1—Stove Welder.

can be raised and lowered by a hand-wheel and locked in position at any desired height, and the dies are water-cooled to increase their life. The head is of the swivel type and is controlled by either a hand or a foot lever, a counterweight being provided to return the upper die to the stop position when not in use. The machine has a capacity for welding sheet steel of from No. 10 to No. 30 gage, and the maximum power consumption is 20 kw. The welder contains a transformer reducing the ordinary 110-volt to 440-volt current, according to specifications and winding, to about 5 volts, the full-load secondary current being approximately 4000 amp.

The No. 124 welder has a maximum capacity of 10 kw and welds stock of from No. 18 to No. 30 gage sheet steel. It occupies a floor space of 31 in. by 44 in. and is equipped with round upper and lower horns 2 in. in diameter. Its capacity ranges from 80 to 150 welds per minute, and it is easier to operate than a punch press. At the moment when the dies apply the final pressure to force the molten metals together the switch is automatically opened, making it impossible to draw an arc or to burn the stock when the die

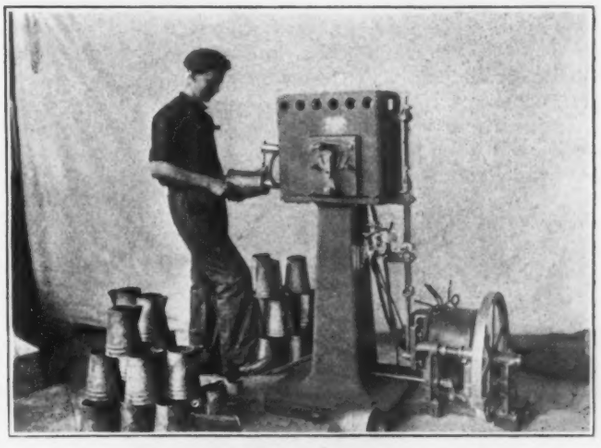


Fig. 2—Automatic Welder.

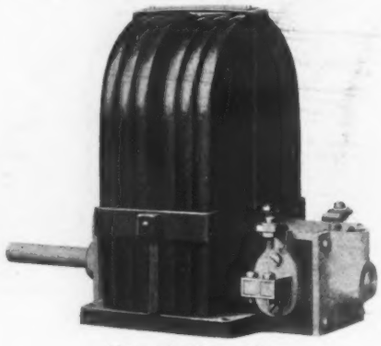
points are drawn apart. Each welder described above is equipped with a regulator switch cutting in or out various transformer coils to provide the necessary current for varying thickness of stock. The smaller welder is frequently driven by a 2/3-hp variable speed motor and is built for operation on single-phase alternating current of from 110 volts to 440 volts, as specified.

Striking economies are being secured by the use of electric spot welders in shops where riveting was formerly the standard practice. Gas ranges, pans, stove runners, coffee pots, wire frames, lockers, pails, small tanks and many other utensils are being handled by these machines at a lower cost than when riveted. With energy at 5 cents per kw-hr., sheet steel of No. 28 gage, 1/64 in. thick, can be welded in three-tenths of a second at a cost of 2.25 cents per 1000 welds, and No. 3 gage sheet steel, ¼ in. thick, can be welded in seven seconds at a cost of 3.4 cents per 1000 welds. In welding 3/16-in. barrel hoops, an operator with a little experience can easily weld 1000 per hour. In the case of one stove manufacturer, 655 ranges and 582 closets were welded electrically in one month at a total labor cost of $87 and an energy cost, at 6 cents per kw-hr., of $5.75, or a total of $92.75. Before installing the welder the manufacturer paid 35 cents each for riveting ranges, so that 655 ranges cost $229.55 for riveting and $8.75 for rivets, or a total of $238.30 under the old method. The saving by the use of electric welding was approximately $150 per month. One workman can weld electrically from 150 to 160 high closets in nine hours, and one worker can weld from thirty to forty ranges in the same period. In another case a manufacturer paid $4.50 per hundred for the riveting of stove runners used to support the wire shelves of stove ovens. After installing an electric spot welder the cost per 100 was reduced to 75 cents.

ELECTRIC SPEED INDICATOR.

The electric speed indicator illustrated herewith consists of a magneto-generator and a direct-current measuring instrument. The magneto is attached to a pulley or shaft of the apparatus the speed of which is to be measured, and since the voltage of the magneto-generator is proportional to its speed the voltmeter being properly calibrated indicates the speed directly at any time. When operating at 1000 r.p.m. the apparatus generates 25 volts so that the meter may be calibrated for any unit, such as revolutions per minute, cycles per second, percentage fast or slow, or feet per minute.

The meter may be mounted at a distance from the indicator so that it is possible to place a number of the meters in one place, making it convenient for those in charge to note the performance of a number of machines at any time.

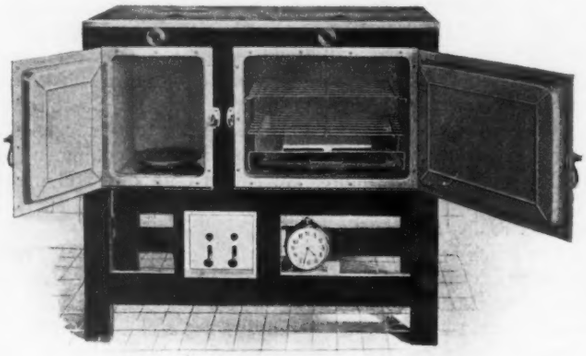


Magneto-Generator.

The magneto-generator is manufactured by the Holtzer-Cabot Electric Company, Brookline, Mass., and has been especially designed for use with meters manufactured by the Westinghouse Electric & Manufacturing Company.

AUTOMATIC ELECTRIC RANGE AND FIRELESS COOKER.

The Copeman Electric Stove Company, Flint, Mich., has recently placed on the market a line of electric ranges in which automatic operation in combination with the fireless cooker principle is a noteworthy characteristic. These



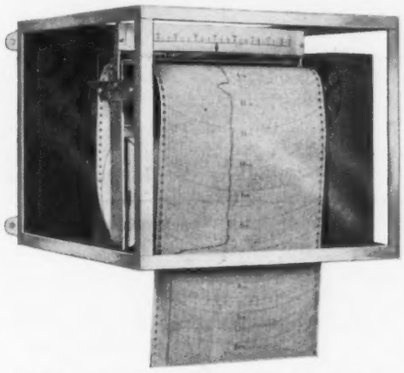
Automatic Electric Range and Fireless Cooker.

stoves are made in three sizes, to serve from two to twenty persons, and on account of their automatic features are colloquially known as "silent servants." They are built with from one to three compartments and in each installation are equipped with a special type of alarm-clock movement which switches energy into circuit at a predetermined time and an adjustable thermostat which cuts off the supply of energy after the temperature of the cooking compartments has risen to the point for which the thermostat has been set by the cook. The edibles then continue to cook by the retained heat of the ovens, the latter being inclosed by insulation which enables the food to be kept hot for hours without the consumption of additional energy.

In the two-compartment stove, which is representative of the line, separate baking and boiling sections are supplied, which can be operated independently or jointly. Both ovens are controlled through the circuit-breaker by means of the clock, or they can be set and operated manually. The dimensions of the boiling compartment are 13.5 in. by 10.5 in. by 10.25 in., the baking compartment being 13.5 in. by 18.75 in. by 12 in. The standard equipment for this stove is one 8-in. heater for the boiler, one bar heater in the oven, one heat shield and distributor, two wire oven racks, two receptacles on top to receive the heaters when external cooking or heating is required, and two snap switches for operating the top heaters. These extra heating units make it unnecessary to remove the heaters from the compartments except for cleaning purposes. The connected load is 1815 watts at 110 volts, the stove operating upon a circuit of No. 10 rubber-covered wire. The largest stove of this type has a connected load of 3960 watts, and the smallest size requires a maximum of 1485 watts, assuming all units in full operation. Either alternating-current or direct-current supplies may be utilized. On account of its economical characteristics the Copeman stove is not designed for high-speed cooking, as in a gas range, but the makers contend that the saving of a small amount of time is of less importance than the economical consumption of energy and the improved quality of cooking when the process is not hurried. The Copeman clock, which has been specially built for stove operation, resembles an ordinary alarm clock with the exception of the increased strength in the spring drive. The stove enables meals to be prepared and left to cook with a freedom impossible in a coal or gas range. The makers state that it will compete in economy with gas at $1 per 1000 cu. ft. where electricity is utilized at 10 cents per kw-hr. or less.

CONTINUOUS CHART RECORDING PYROMETER.

The Brown Instrument Company of Philadelphia and its associate company, the Keystone Electrical Instrument Company, have recently brought out a continuous chart recording instrument, particularly designed for use as a pyrometer, but which can also be used for recording voltage, current, revolutions per minute, mechanical operations, etc., where a small current of electricity is required to operate a recording instrument.



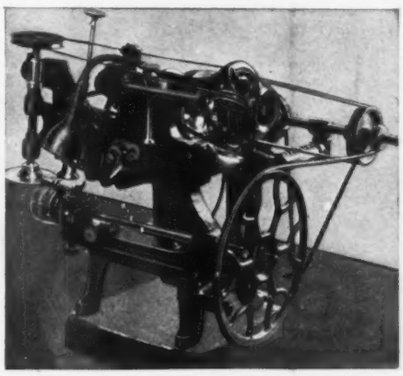
Continuous Chart Recording Pyrometer.

This instrument is of the frictionless type, the pen making a single dot of ink momentarily on the paper at short intervals, every ten seconds or every minute as desired, these dots practically forming a continuous line. The instrument carries a six months' supply of recording paper, traveling a little over an inch an hour, which does away with the necessity of changing the charts daily, and for many operations the continuous chart is preferable. The record can either be torn off as desired every day or once a week or it can be allowed to roll up continuously.

The instrument is handsome in appearance, and is provided with a plate-glass case, as shown in the illustration.

FIXTURE FOR INTENSE SPOT ILLUMINATION.

The so-called Permel lighting system is said to offer a solution of the problem which has been encountered in certain industrial shops. Such operations as stitching, skiving, eyeletting, vamping, embossing and buttonholing require a very high intensity of illumination over a very small area. It has been desired to secure the necessary light without waste and without handicapping the operator with an excessive amount of glare, and this has met with considerable difficulty.



Machine Equipped with Fixture for Spot Illumination.

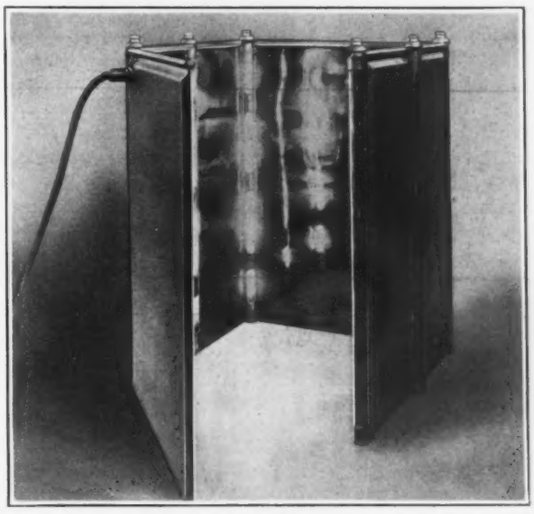
The essential part of the Permel fixture is a reflector socket only 2⅛ in. in diameter, accommodating a special tungsten lamp. This reflector socket is welded to a substantial brass tube which carries the wires to the lamp. This brass tube is so bent as to fit closely the body of the machine for which it is designed and to which it is securely fastened by metal straps, so that the entire unit practically becomes a part of the machine.

The lamp used with the Permel unit is a 6-volt, 5.5-watt tungsten-filament lamp rated at 4 cp. A bayonet-type candelabra base effectually prevents the lamp from jarring loose from its socket. The design of the reflector is such that this lamp gives 8.7 cp directly under the unit, this being equivalent to the illumination given by six 60-watt carbon lamps equipped with good reflectors and hung 3 ft. above the table.

The Permel fixtures are manufactured by the Holophane Works of the General Electric Company, Cleveland.

COLLAPSIBLE ELECTRIC BATH.

The private electric bath cabinet, a convenience heretofore beyond the reach of many of moderate means, bids fair to become extensively popularized through a type lately put on the market by the Metropolitan Engineering Company, Brooklyn, N. Y. The inventor, Mr. Thomas E. Murray, vice-president of the New York Edison Company, has succeeded in producing a cabinet which, while moderate in price, incorporates the most desirable features of the electric bath. Built of copper, nickel-plated, it is composed of four walls or leaves each of which in turn can be folded again and the whole accommodated in a space only 5 in. in thickness. Inside these walls, which obtrude slightly on the exterior in flat panels, are dead-air chambers designed to prevent the escape of the heat generated by the bath. The heat is supplied by thirty-six electric lamps ranged in lamp chambers or pillars mounting along the seams, requiring the expenditure of 1.5 kw. The surrounding walls, which rise to a height of a little over 4 ft., together with the top through which the bather's head appears, are lined with highly polished nickel to facilitate the reflection of the light rays. The inclosed space covers an area of 9 sq. ft. At the rate of 10 cents a kw-hr. the cost of operating the cabinet for an hour would be 15 cents, or 5 cents for the average bathing period of twenty minutes. The contrast with expenditure of $2 or $3 necessitated by an electric bath in a well-appointed institution is augmented by the convenience of having such a cabinet in one's own bathroom or bedroom.



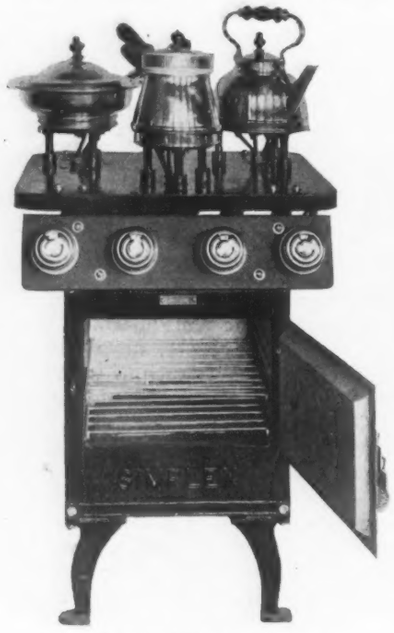
Collapsible Electric Bath.

AUTOMATIC VOLTAGE REGULATOR FOR HOUSE LIGHTING.

In connection with the recent development of a system of house lighting for country places remote from central-station service, Thomas A. Edison, Inc., has brought out an automatic regulator of the motor-operated type which responds to the cutting in or out of a single 25-watt lamp. The regulator consists of a rheostat, the arm of which is driven through a worm gearing by a 30-volt motor installed on a horizontal shaft in a polished-metal case of dust-proof design, and a solenoid with carbon contacts controlling the positive and negative rotation of the motor. The solenoid is connected permanently across the line and is responsive to small or large changes in voltage due to the variation of the number of lamps in circuit. Resistance is cut in or out in the circuit between the battery and the lamps as required. The rheostat arm is equipped with a pigtail contact lead to supplement the conductivity of the arm proper. The device is marketed by the Edison Storage Battery Company, Orange, N. J.

A MINIATURE ELECTRIC RANGE.

Among the exhibits of the Simplex Electric Heating Company, of Cambridge, Mass., at the Boston Electric Show, an electric range of miniature design has attracted much attention. The range is illustrated in the accompanying photograph. It consists of an 11-in. by 10.5-in. by 10.5-in. oven inclosed in a Russia iron frame and lined with asbestos and a top or stove section carrying three disks elevated above the surface and designed to heat a saucepan, tea-kettle and double boiler, or any other small utensils from 4.5 to 6 in. in diameter. Each heating element is designed for three temperatures and is provided with a three-way independent switch mounted on a slate panel at the front of the range. The maximum heat service of the oven requires



Miniature Electric Range.

the expenditure of 752 watts, the other elements consuming about 920 watts total at full heat. The oven has double walls packed with asbestos and is built so that no draft can enter or leave it. The elevation of the disk stoves above the surface of the range leaves an air space between the two which economizes the use of heat. The outfit operates at 110 volts and is used for light service.

EXHIBITS AT RAILWAY ELECTRICAL ENGINEERS' CONVENTION.

An attractive collection of exhibits was shown by the Railway Electric Supply Manufacturers' Association at the recent Chicago convention of the Association of Railway Electrical Engineers. Manufacturers of lamps, batteries and various forms of electrical supplies presented well-arranged displays. Much attention was attracted by the new ball bearings for axle-light generators for car lighting. The number of exhibitors was about forty, and among them were the Adams-Bagnall Electric Company, Adams & Westlake Company, Appleton Electric Company, Benjamin Electric Manufacturing Company, Central Electric Company, Crouse-Hinds Company, Cutter Electrical & Manufacturing Company, George Cutter Company, Economy Fuse & Manufacturing Company, Edison Storage Battery Company, Electric Storage Battery Company, Electrical Testing Laboratories, Esterline Company, General Electric Company, Gould Coupler Company, H. W. Johns-Manville Company, Kerite Insulated Wire & Cable Company, National Metal Molding Company, National Electric Lamp Association, Nelite Works of General Electric Company, Pass & Seymour, Sangamo Electric Company, Safety Car Heating & Lighting Company, Thompson Electric Company, United States Light & Heating Company, Western Electric Company, Westinghouse Electric & Manufacturing Company and Willard Storage Battery Company.

A NEW TYPE OF ELECTRIC SIGN.

A distinctive design of electric sign has recently been placed on the market by the American Sign Company of New England, Portland, Me., the special feature of interest being the use of a powerful meniscus lens at short intervals in the sign case, as illustrated in the accompanying photograph of a vertical equipment used outside a bowling alley. The signs are made entirely of metal, a framework of angle steel being used in large sizes, and the apparatus

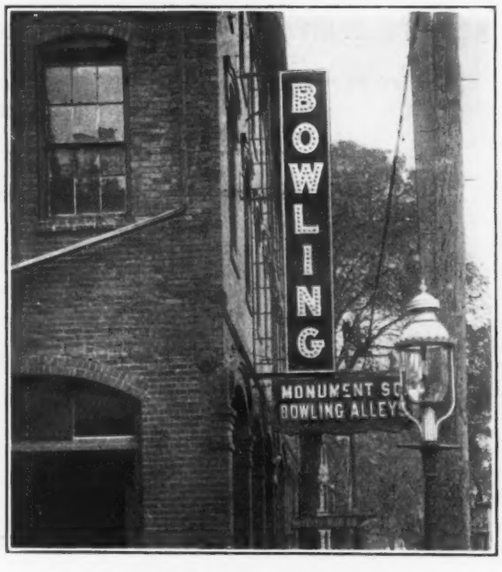


Fig. 1—Electric Sign with Special Lenses.

is water-tight and dust-proof, requiring no cleaning. The illumination comes entirely from the interior, the light rays being transmitted through the special lenses which outline the wording or design required. Any one of three styles of incandescent lamps may be used—ordinary carbon-filament lamps of any desired candle-power or tungsten-filament lamps in 25-watt or 5-watt sizes. The latter are of

low voltage and when used are wired in series, the makers furnishing a suitable transformer.

The lens is patented and, as shown in the accompanying drawing, is provided with a screw thread by which it is attached to the iron plate of the sign box, there being no glue to become loose or spring fasteners to grow weak and allow the lens to fall to the sidewalk. On account of the equal distribution of light in the interior the general effect is not changed and the outline of the letters is not marred in case one or two of the lamps inside become extinguished. The interior finish is reflector white, and the makers contend that the energy consumption, on the basis of one 25-watt lamp for every 2 sq. ft. of sign area, is 80 per cent less than that of the ordinary all-lamp electric sign. The company manufactures lenses from ½ in. to 3¼ in. diameter and supplies the former in both clear and colored glass as desired. The electrical construction conforms to the requirements of the Underwriters' National Electrical Association.

Fig. 2—Cross-Section of Lens.

HEATING APPARATUS FOR SHOE INDUSTRY.

Apparatus recently brought out by the Boston Last Company marks a new development in the application of electric heating to shoe machinery and manufacturing processes bearing upon the production of high-class footwear. This equipment includes an electrically heated cork filler, an electric wax pot for Goodyear stitching and welting service and a sole dryer operated by plate heaters.

The cork filler consists of a copper basin, an 8-in. diameter flat heating element, a galvanized-iron cylindrical container and a frame carrying these, and also a combined knife heater and burnisher. The contents of the basin are heated separately from the knife holder and burnisher. The basin can be heated from a cold state to a temperature of about 300 deg. Fahr. in twenty minutes, and the heating element is provided with three heats controlled by an external switch. The cork filling is kept at the required temperature with an expenditure of about 275 watts, the initial heating requiring 800 watts maximum. The basin carrying the filling is 15 in. in diameter and 8 in. deep. A 6-in. disk has been installed slightly above the concentric with the 8-in. heater to provide an improved distribution of air currents around the copper basin. The knife heater has a capacity of two knives and with the burnisher consumes 100 watts, one heat only being required. The heating elements are of Simplex make and are of the non-inductive type, designed for both alternating-current and direct-current service at 110 volts. In operation the basin is run for ten minutes at the full heat, and then the low heat serves for the rest of the working period. The apparatus eliminates all the defects encountered in steam-jacket heating.

The wax pot is attached to the stitcher and welter independently from the usual steam service by a bracket and the device has also a tension wheel and a guide wheel heated independently from the wax pot. The power consumption of the wax pot varies from 176 to 70 watts, according to the amount of external resistance in circuit, and the tension and guide wheels consume together from 60 to 100 watts. The wax pot is provided with a spout at the top which feeds any wax which may boil over back into a reservoir connected with the pot at the bottom, so that practically no wax is lost in case of overheating. Two spindles are cast on the frame carrying the tension and guide wheels, and these have a total capacity of six spools of waxed thread. The capacity of the wax reservoir is six cakes. The tension wheel is adjustable by a knob and spring to give the required take-up and is also used on the bobbin winder employed in stitching work. In practice the stitcher is equipped with electric shuttle heating and the take-up device has a heater attachment. The total maximum power consumption of a standard stitcher, with the above wax pot and auxiliary equipment, is 450 watts for heating service, all external resistance being cut out of circuit. A ½-hp motor is required to operate the machine. The wax pot and wheel-heating elements are of Simplex make and are designed for 110-volt or 220-volt alternating-current or direct-current service, as desired.

The sole dryer is built in a unit section 45 in. long and 18 in. wide. It consists of four plate heaters carried below a wire screen in an adjustable frame, the soles being set upon the screen and a suitable rest bar running parallel to its length on either side. Three degrees of heat are provided, the range of consumption being 770 watts to 2200 watts. The capacity of the dryer is thirty-six soles, and it is portable in character, Simplex Electric Heating Company's elements being employed.

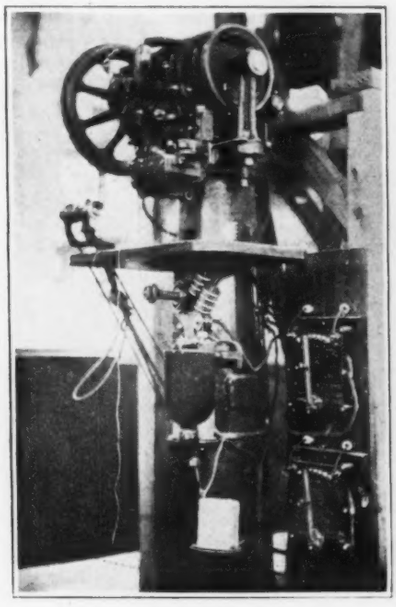


Fig. 1—Electrically Operated Stitcher.

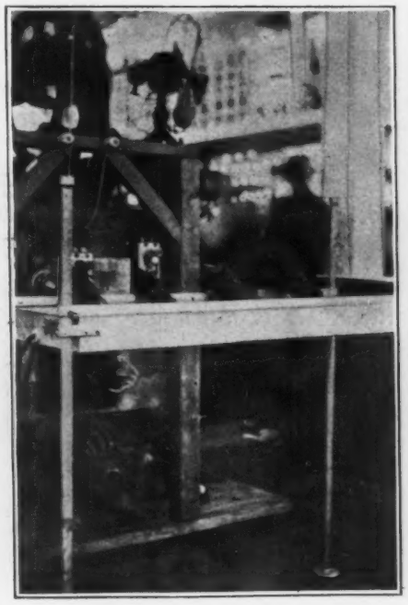


Fig. 2—Electric Sole Heater or Drier.

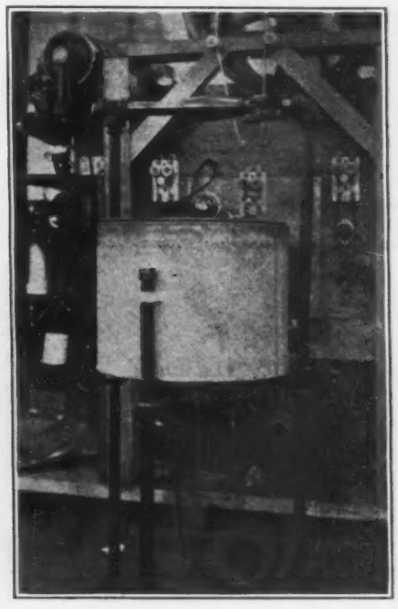


Fig. 3—Electric Filling Heater.

ISOLATED PLANTS IN MANUAL-TRAINING HIGH SCHOOLS AT GRAND RAPIDS.

The motor installations in the Central and Union High Schools of Grand Rapids, Mich., are exceptional examples of electric drive for manual-training purposes. These installations are interesting in that each school has its own generating plant for the manual-training load.

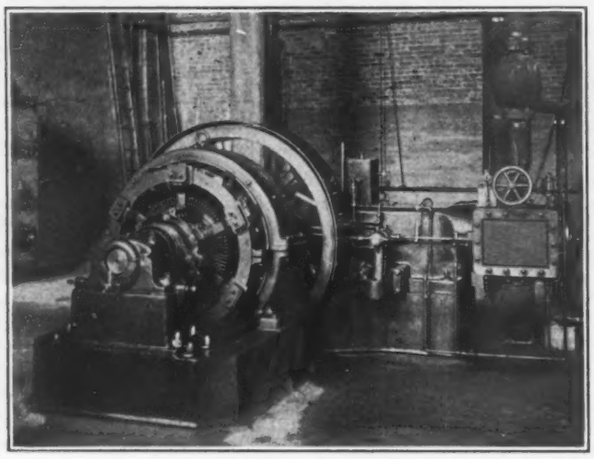


Fig. 1—Engine Room, Central High School.

In Fig. 3 is shown the wood-turning room of the Central High School. Here the wood-turning lathes are driven by one motor from a line shaft and all other machines have individual motors arranged for belt drive. Other manual-training rooms at this school are the bench room and the preparation room. The motor equipment installed in the Central High School is distributed as follows: Bench room, four machines, directly driven, 11 hp; wood-turning room, six machines, 19 hp; preparation room, one machine, 3 hp. From this it may be noted that there are eleven motor-driven machines aggregating 33 hp. There is also a

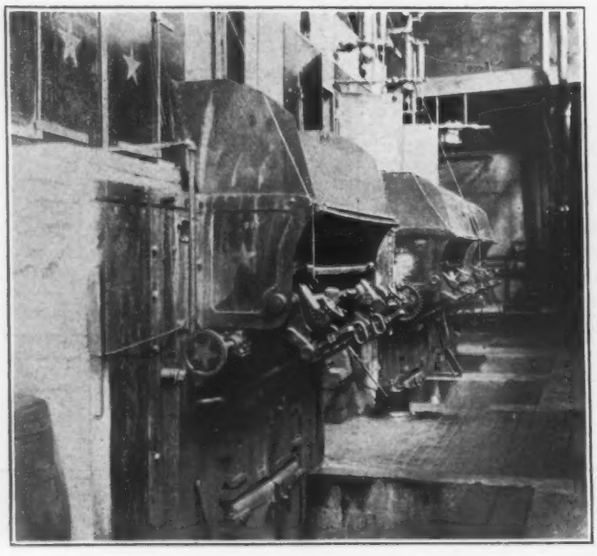


Fig. 2—Boiler Room, Central High School.

group-drive arrangement aggregating 20 hp. These shops can accommodate 160 pupils per day.

Energy for the manual-training department is generated in an isolated plant which is located in the basement in the rear of the building. The engine room, shown in Fig. 1, contains a Westinghouse direct-current, three-wire generator directly connected to an automatic cut-off engine built by the Ball Engine Company, Erie, Pa. The generator is of the commutating-pole type, rated at 75 kw, 125/250 volts, 300 amp, at 275 r.p.m. In connection with the three-wire system, two Westinghouse 1.33-kva, 13.5-cycle, 177/88-volt balance coils are used. These coils take care of any unbalancing that might occur in the system. They are placed behind the switchboard as shown in Fig. 4. The switchboard, which is mounted on an angle-iron frame,

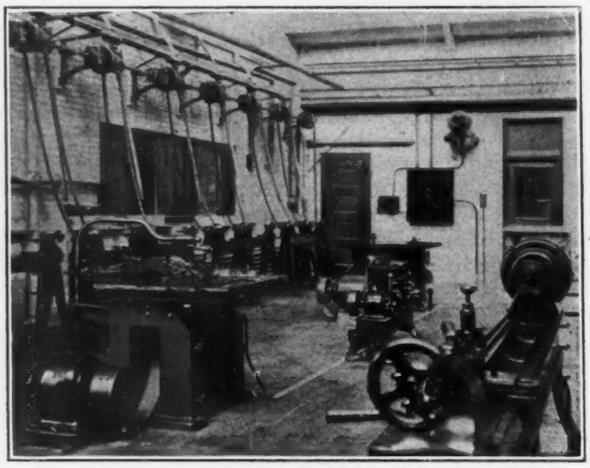


Fig. 3—Wood-Turning Room, Central High School.

consists of four panels. The generator panel on the extreme left is equipped with two Westinghouse 500-amp direct-current ammeters, one Westinghouse 300-volt direct-current voltmeter, a field circuit rheostat, two generator switches and an equalizer switch. Two generators can be handled by this one panel, but at present it is handling only one. Panels No. 2 and No. 3 receive energy from the municipal plant for lighting the school building. Lamps aggregating 70 kw in rating are installed in this building. The fourth panel is connected to the mains of the Grand Rapids-Muskegon Power Company and controls a sump motor in the boiler room and also a motor for ventilating

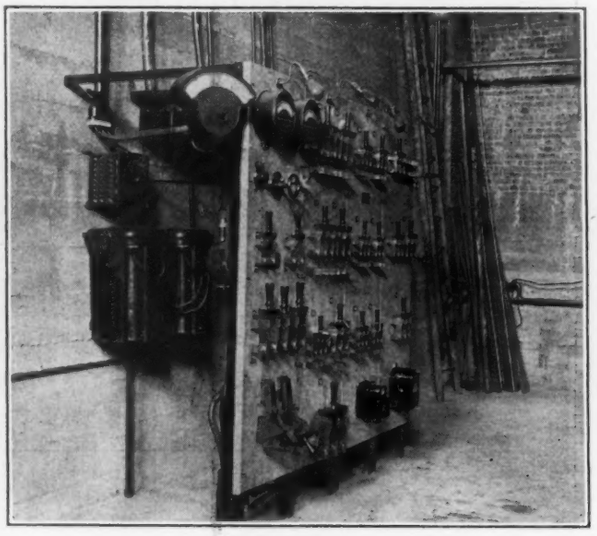


Fig. 4—Switchboard, Central High School.

purposes. An emergency connection is arranged so that energy for lighting may be supplied from this panel. All wiring in this building is in conduit.

The boiler-room equipment consists of three Wicks horizontal water-tube 225-hp boilers with Roney stokers, a Cochrane feed-water heater, a feed pump and a pressure-raising pump. Very exacting conditions are imposed upon

these Roney stokers. The school is located in one of the best residential sections of the city and smoke from the plant is not permissible. The coal used is a poor slack, thus making it all the more important that it be consumed on the stokers in such a way as to prevent smoking as much as possible.

Another installation similar to that at the Central High School is to be found in the Union High School, at the corner of Turner Avenue and Fourth Street, in the same city. The shops at this school are more extensive than those referred to above and consist of bench, wood-turning, preparation, machine and forge shops. There are a large number of motors installed in this school, reaching a total rating of 101.5 hp and distributed as follows: Bench room, six motor-driven machines, 17 hp; wood-turning room, seven machines, 23 hp; preparation room, three machines, 11 hp; machine shop, five machines, 12.5 hp; forge shop, four machines, 20.5 hp. There are in all twenty-six machines equipped with individual motors, aggregating 84 hp, and group-driven machinery with a total motor rating of 17.5 hp. These shops can accommodate 320 pupils per day. Energy for the motor service is supplied by a Westinghouse 75-kw, 125/250-volt, three-wire generator directly connected to an 18-in. by 14-in. Ball engine. The stoker, boiler and switchboard equipments are similar to those in the Central High School, the electrical equipment of which has just been described.

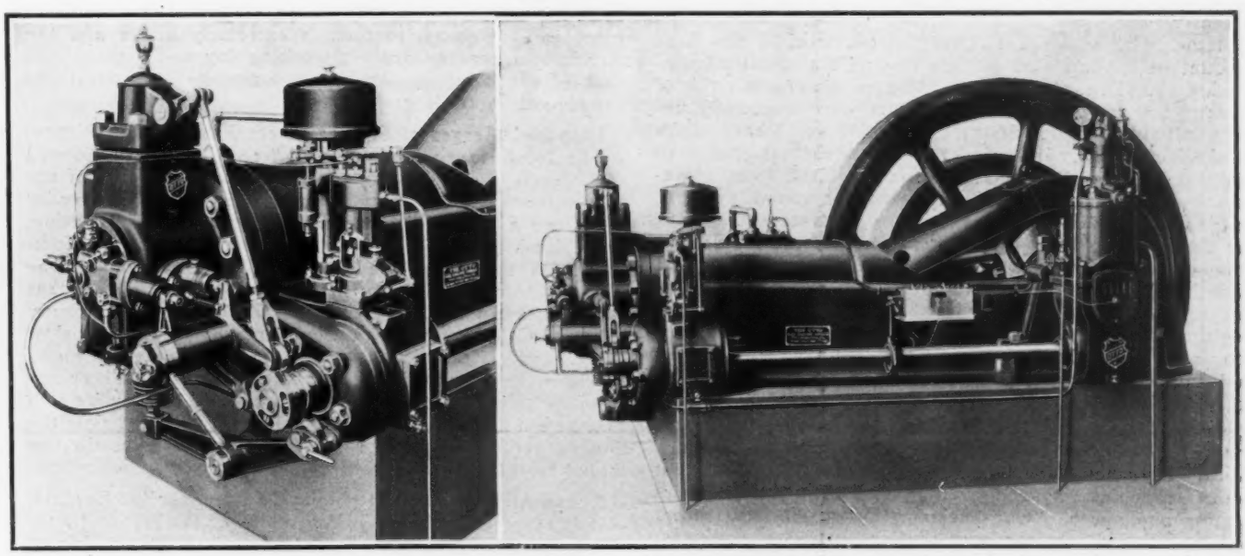
HORIZONTAL CRUDE-OIL ENGINE.

A horizontal internal-combustion engine of the Diesel type, operating on the four-stroke cycle, has lately been placed on the American market. This engine is designed for operation with the heavy crude or residual oils obtained in refining mineral oils, available at prices ranging from 2½ cents to 4 cents per gallon. It is a complete unit within itself and requires no auxiliaries. Compressed air is employed for starting, so that a single attendant can place one of these engines, of any size, in operation without extra assistance. No ignition apparatus is required with engines of the Diesel type. The manufacturers claim that any kind of low-grade liquid fuel may be employed, such as gas oil, solar oil, tar oil and similar products, besides the crude oil before mentioned.

During the first outward stroke of the piston a charge of pure air is admitted into the cylinder through the inlet valve. On the return stroke this air is compressed until its temperature is more than sufficient to ignite the fuel. The latter is injected into the heated air at the end of the compression stroke and ignited spontaneously. The combustion continues steadily for a portion of the third or expansion stroke. On the fourth stroke the spent gases are expelled through the exhaust valve and port. The quantity of fuel injected by the oil pump is automatically regulated by the governor to conform with the load on the engine. This is accomplished by control of the by-pass valve on the overflow chamber.

The engine is started by means of compressed air at low pressure, supplied from a reservoir which is filled from the compressor on the engine. The admission of air into the cylinder is controlled by a mechanically operated starting valve. A low-pressure safety valve set at 220 lb. is placed on the compressor, and a high-pressure safety valve set at 1200 lb. is provided on the fuel-injection valve. Another safety valve set also at 220 lb. is attached to the compressed-air reservoir. These engines, according to the manufacturers' claim, will develop a brake-hp-hour on about 1/15 gal. of fuel. When using fuel oil of average heating value, about 18,000 heat units per pound, the consumption per brake-hp-hour is given by the manufacturers as follows: At full load, 0.50 lb.; at three-quarter load, 0.56 lb.; at one-half load, 0.62 lb.; at one-quarter load, 0.74 lb. The speed regulation, it is claimed, is ordinarily within 4 per cent, but on special engines designed for electric service the size and weight of the flywheel are so proportioned as to keep the regulation within 3 per cent above or below the mean rated speed, under such gradual change of load as is experienced in common practice.

This type of engine has been built at the Otto works at Cologne for many years and is being placed on the market in this country by the Otto Gas Engine Works, Philadelphia, Pa. Every advantage has been taken of the twelve years of practical experience in the German works. Among the severe tests which it is reported that one of these engines successfully withstood was a long run on heavy oil containing 6 per cent of asphaltum. This oil is so thick that a larger fuel pipe was necessary to convey it from the tank to the engine. The same horse-power was developed with this grade of oil as with lighter oils, and the engine, it is said, showed almost complete combustion. The manufacturers claim that they are the first to introduce the horizontal type of Diesel engine in the industrial establishments of this country. Details of the valve mechanism and a side view of the engine are reproduced herewith.



Horizontal Crude-Oil Engine.

Industrial and Financial News

EXPANSION is still the keynote of the business situation, and, judging from the present outlook, will continue to be so for the remainder of the year. Approach of the presidential election is apparently having little retarding effect upon the trade movement. The harvesting sections are, naturally, showing the greatest activity at this time, but the wave of good business originating in these localities is sweeping rapidly all over the country. Manufacturers in many instances are sold far ahead and are working day and night in order to meet the demand for their products. This is the case with many of the cable manufacturers, who are working double turns and are three months behind on their orders. Similar conditions are reported by one of the pioneer manufacturers of electric-heating appliances, as noted below. The high rate of activity that has prevailed for the past six months at the works of the Crocker-Wheeler Company shows no signs of diminution. That a decidedly prosperous condition exists in the central-station industry is shown in the many increases in earnings and also in the remarks of a member of a leading conduit engineering firm, cited below, calling attention to the vast amount of underground construction that is being done by small central-station companies that were financially unable to have such work done a few years ago. The United Railways & Electric Company of Baltimore is in the midst of its most prosperous year, and recently increased the wages of all its employees.

Conduit Engineers Are Having a Record Year.—Evidence that prosperity and excellent prospects for new business prevail throughout the greater part of the central-station industry is shown in the remarks of a member of one of the foremost conduit engineering and contracting concerns in the country, who said in part this week: "We are doing more business this year than ever before in our history, and as activity in our field varies in direct proportion with that of the central-station industry, it may be inferred that the majority of central-station companies are improving in financial strength, are doing an excellent business and have a large amount of new load in sight to justify the extensive additions we are making to their underground systems. One significant feature of our work is the large amount of conduit that we are placing for small central-station companies, by which I mean companies in cities of from 30,000 to 40,000 population, that were financially unable to have such work done four or five years ago. Much of the increase in our business is due to natural growth of the lighting industry, and some has resulted from movements for replacing overhead by underground systems, originating from a desire to beautify city streets, etc. Thus far this year we have been doing extensive work in about fifteen states in the Union and have been very busy in Canada. We are doing a great deal of work in the Dominion at present. Ordinarily at this time of the year we begin calling in our Canadian crews, but we now have over 1000 men at work in the Dominion from coast to coast and have plenty to keep them occupied for some time to come."

Electric-Heating Appliances in Demand.—"We have been working at our maximum limit, including night work, since April," says the manager of one of the oldest and best known concerns engaged in the manufacture of electric-heating appliances. "Our business thus far in 1912 shows a very material increase over that in 1911," he continues, "and this is undoubtedly due to the broader public interest taken in electrical development as well as to the natural growth that our business has shown for many years." One of the noteworthy features of this concern's business is that the demand for its products spreads over the entire line and is coming from all parts of the country, a condition which indicates the high degree of general interest taken in heating appliances. There have been no noteworthy changes in prices for appliances in the last year or so, according to this company, nor does it look for any material changes in prices in the near future. While cost of production is higher than it has been in the past and shows an ascending trend, increased activity and larger output are expected to offset this and keep prices about the same. The greatest drawback to expansion in the electric-heating field, this concern feels, is the inability to keep abreast of the demand for new applications and for broader development of appliances already on the market.

Going Ahead with Cheat River Project.—It is learned that the decision recently handed down by Judge Mason, of the Circuit Court of Monongalia County, W. Va., does not prohibit the building of a dam across the Cheat River for hydroelectric purposes, as was noted in these columns last week. The decision handed down by Judge Mason was to the effect that while the West Virginia Development Company, a Kuhn enterprise, has the right of eminent domain to build a dam at the site planned, certain changes in the plans to better meet the needs of such logging as is carried on along the Cheat River must be made before the condemnation of properties needed in completing the dam project will be allowed. The work on the development is in no way held up. Unless Judge Mason's decision is reversed, the West Virginia Development Company will make the required changes in plans. These changes involve only alterations in the log chutes. Logging as an industry is practically extinct on the Cheat River, but the decision of the court that the latter is a navigable stream of the second class, under West Virginia law, means that it is a floatable stream and that proper provision must be made for logging.

Activity Continues at Crocker-Wheeler Works.—There has been no diminution of the high rate of activity that has prevailed at the works of the Crocker-Wheeler Company, Ampere, N. J., for the past half year. Extensive comment by Dr. Schuyler S. Wheeler, president of the company, upon the business situation and outlook in the electrical industry appeared in these columns on Sept. 14. Thus far in the current month business has been very brisk. In addition to heavy sales of motors, there has been an unusual number of orders for engine-type generators, transformers and motor-generator sets. The company has also received many orders for three-wire generators, synchronous motors and alternating-current generators. Demand for all of the company's products, in fact, is extremely active and the factories in consequence are working day and night. Officials of the company attribute the activity to general improvement in trade conditions.

Proposed Merger of Surface Street Railways in Chicago.—The local transportation committee of the City Council of Chicago is endeavoring to bring about a merger of the two surface street-railway companies in Chicago in order to secure a universal transfer system and better routing. L. A. Busby, president of the Chicago City Railway Company, has told the committee that the unification can be brought about if the city of Chicago will guarantee that the net earnings of the Chicago City Railway Company and the Chicago Railways Company shall not fall below 7 per cent. If this proposition should be adopted, the city would make up any deficit in the companies' net earnings from its 55 per cent of the "net receipts." Mr. Busby said that he did not think that the earnings would fall below the desired return of 7 per cent, but the companies do not intend to take any chances.

Lyons-Atlas Company to Make Oil and Gasoline Engines.—It is reported that Mr. J. W. Lyons, of the Lyons Boiler Works of De Pere, Wis., has purchased the Atlas Engine Works of Indianapolis from the receivers at judicial sale, and that the Lyons-Atlas Company of Indianapolis has been formed to manufacture "Silent Knight" gasoline automobile engines and oil engines of the Diesel type.

United Metals Selling Company to Sell Lead.—Announcement has been made by the United Metals Selling Company that it will shortly enter the lead market as agent for the International Smelting & Refining Company. It will become a competitor of the American Smelting & Refining Company in its new field.

Will Meet Long Acre Bond Interest.—Announcement that the Long Acre Electric Light & Power Company, of New York, is in no danger of being absorbed or eliminated from the central-station field by the New York Edison Company, following the recent sale to interests identified with the latter of a majority of the Long Acre company's $500,000 4 per cent bonds, on which the interest has been long in default, as was noted in these columns Sept. 28 and Oct. 5, was made this week by John C. Sheehan, until recently a vice-president of the last-named company. While it was expected that the purchasers of the bonds by beginning foreclosure proceedings on the basis of the defaulted interest would obtain possession of the company and its franchises, and thus eliminate possible competition with the New York Edison Company, Mr. Sheehan states that the Long Acre company is now in a position to meet all of its obligations and will do so. As was noted on Oct. 19, control of the stock of the company was transferred last month to the banking houses of A. B. Leach & Company and Harvey Fisk & Sons, and new officers for the public-utility company were elected. Mr. Leach said at that time that the Long Acre company was going to pay its debts. He said this week concerning litigation to prove the franchise of the Long Acre company invalid: "We expect that the Court of Appeals will hand down a decision favorable to our company any day now in the suit appealed by the New York Edison Company to the highest court in the State. Pending that decision the matter of payment of coupons on the $500,000 4 per cent bonds of the Long Acre Electric Light & Power Company will remain in abeyance. Should the decision prove favorable to the Long Acre company, which would confirm the decision of the Appellate Division of the Supreme Court, the coupons for the past six years would be paid as presented. There is no use doing anything in the matter until the case is settled once for all by the Court of Appeals."

Earnings of Great Western Power Increasing Rapidly.—Mortimer Fleischhacker, president of the Great Western Power Company, said recently: "Our company is enjoying a period of great prosperity, its output for the present month being far greater than at any time before in the history of the enterprise. New contracts amounting to over $250,000 per annum have recently been made with various consumers of light and power, and all this additional business will be connected up within the next few months. Through the great development of electric energy and the immense storage of water to be used in the irrigation of farming lands, I consider our enterprise will be one of the greatest factors in the upbuilding of the State of California." Mr. Fleischhacker has denied rumors that have been in circulation to the effect that signs of weakness have developed in the huge concrete dam which his company is building in connection with the enlargement of its hydroelectric plant on the Feather River in California. In a statement issued recently he says that he has made an inspection of the properties of the company, including the Feather River development, and found everything in satisfactory condition. The company has had 600 men constantly employed at Feather River Canyon in constructing the dam that will create the huge reservoir at Big Meadows, a description of which appeared on page 184 of the *Electrical World* of July 27, 1912. With approach of winter, this force is being reduced, but 1000 men will be employed next year. It is expected that the dam will be completed in the summer of 1913.

May Extend Washington Water Power's Lines to Republic Mining District.—Officials of the Washington Water Power Company are considering the advisability of building a 60,000-volt, 60-cycle, three-phase line, 110 miles long, from the Spokane River plant to serve Republic, Wash., and the adjacent mining district. A trip to the mining camps for the purpose of looking over the prospects for additional motor-service load and finding out whether the prospective revenue from this source would justify the building of the line was made recently by the following, identified with the Washington Water Power Company: D. L. Huntington, president; C. S. McCalla, general manager; M. C. Osborn, commercial agent; Harold T. White, 14 Rector Street, New York, a large stockholder, and Benjamin B. Lawrence, a director. J. C. Harper, general manager of the Republic Mines Corporation and of the North Washington Power & Reduction Company, of Republic, showed the party about the mines. In case the line is built it will follow the water-power company's right-of-way in Stevens County, taking in the mines in the Chewelah district, after which it will go up the Columbia River, cross it at Kettle Falls, and will then go over the Sherman range to Republic. Many prominent mining men feel that the revenue to be derived from the mining operations, as well as that from the new industries which will be attracted to the region by the low rates for electric service, will justify the company in going ahead with the plan.

Progressing with Appalachian Power Company's Development.—Reports made recently to H. M. Byllesby & Company indicate that the large electric-service development of the Appalachian Power Company, to which reference appeared in these columns Oct. 7, 1911, June 5 and Sept. 4, 1912, is proceeding satisfactorily. The Pulaski (Va.) substation has been completed and placed in service. The line between Coalwood and Switchback will be finished within a few days, after which time the Welch load will be carried by the Switchback substation. The 13,000-volt line to Galax will be completed within a week and the Galax substation started. The Pocahontas low-tension service lines have been completed. A 4½-mile extension will be made from Coalwood to supply the Flannagan Coal & Coke Company and the Vaughn Coal Company. The sale of energy for the electrical operation of coal mines will be one of the important sources of revenue for the company.

Holding Corporation for Electric Bond & Share's Texas Properties.—The Southwestern Utilities Corporation, a new holding corporation in which the Electric Bond & Share Company is interested, controls the Southwestern Power & Light Company, which in turn controls the Texas Power & Light Company operating in twelve cities and towns in the "black-land belt" and in six other cities in the State of Texas. The last-named company was formed by the Electric Bond & Share Company last June, as noted in these columns at the time, and took over a number of the public utilities that had been purchased from the American Railways & Lighting Company by the Electric Bond & Share. The Southwestern Utilities Corporation has an authorized capital stock of $15,000,000, and authorized an issue of $15,000,000 five-year 6 per cent notes.

Boston Edison's Stockholders.—Attention was called recently to the fact that the Edison Electric Illuminating Company of Boston has about 3800 stockholders, whose average holdings are forty-one shares. There are thirty-two stockholders owning 500 shares or more, the aggregate of whose holdings is nearly 27,500 shares, or 17 per cent of the 156,037 shares now outstanding. It is stated that the estate of George Peabody is the largest stockholder, having 1863 shares. Up to four years ago J. P. Morgan was the largest stockholder, with 3410 shares. These were disposed of in the summer of 1908.

Utilities Improvement Offering Oversubscribed.—The offering made last week by H. L. Doherty & Company of $5,000,000 6 per cent preferred stock of the Utilities Improvement Company, whose organization was noted in these columns Oct. 19, and whose holdings are described elsewhere in this issue, was found to be more than $10,000,000 oversubscribed when the subscription list closed on Oct. 26. The closing of subscriptions to these securities marked the thirtieth anniversary of the entrance of the Doherty company into the public-utility field.

Milwaukee Heating Company to Change Hands.—To enable The Milwaukee Electric Railway & Light Company to acquire the property of the Central Heating Company of Milwaukee, the Wisconsin Public Service Commission has authorized the former to issue $850,000 par value of common stock, $750,000 of which is to be exchanged for the bonds and mortgage of the Central Heating Company and $100,000 for its common stock.

Kentucky Securities Corporation Preferred Stock Listed.—The preferred stock of the Kentucky Securities Corporation, of Lexington, Ky., has been placed on the market in Cincinnati, Ohio, and Louisville, Ky. The Kentucky Securities Corporation is capitalized at $5,000,000. It controls the Lexington Utilities Company and the Kentucky Traction & Terminal Company, both of Lexington.

Holdings of Utilities Improvement Company.—A note in these columns Oct. 19 concerning the new Utilities Improvement Company, recently formed by H. L. Doherty & Company as a holding corporation for gas and electric properties, gave the capitalization of the new concern, its officers and directors and a list of the properties it will acquire. A few data concerning the electric properties, given below, may be of interest: The Danbury & Bethel Electric Light Company of Danbury, Conn., serves a population of over 24,000 in that city and Bethel, Conn. The electric department has 1091 customers in Danbury and 120 in Bethel, while the gas department has 3973 customers in Danbury and 642 in Bethel, and 33 miles of mains. Its territory contains forty-seven factories engaged in the manufacture of hats or of materials used in their manufacture, together with a large amount of other industries which are desirable prospective customers for motor service. The Athens (Ga.) Railway & Electric Company serves a population of over 15,000 from its own steam and hydroelectric stations, whose aggregate rated output is 3100 kw, and from a hydroelectric station rated at 3000 kw, which it has leased for a term of ninety-nine years. The territory is a promising one from the standpoint of motor load and is expanding rapidly. The Bartlesville Gas, Electric & Railway Company of Bartlesville, Okla., serves a district rich in natural resources, located some 80 miles southwest of Joplin, Mo. Zinc smelters, cement works, machine shops and trades allied with the gas and oil fields of which Bartlesville is a center, and the rapidity with which new industrial enterprises are coming in, afford excellent prospects for supplying large amounts of energy for motor service, in addition to the electric-lighting and gas service furnished by the company. The Toledo Railways & Light Company, which is the largest of the electric companies taken over by the new concern, serves a population of 200,000.

NEW YORK METAL MARKET PRICES.

	Oct. 22 Bid.	Oct. 22 Asked.	Oct. 29 Bid.	Oct. 29 Asked.
Copper:				
Standard, spot	17.20	.....	16.75	.....
	£ s d		£ s d	
London, standard, spot	75 5 0		75 5 0	
Prime Lake	17.60 to 17.80		17.50 to 17.60	
Electrolytic	17.50 to 17.70		17.30 to 17.40	
Casting	17.35 to 17.45		17.20 to 17.30	
Copper wire, base	19.00		19.00	
Lead	5.10		5.10	
Nickel	45.00		45.00	
Sheet zinc, f.o.b. smelter	9.00		9.00	
Spelter, spot	7.60		7.55	
Tin, spot	50.00		50.20	
Aluminum:				
Prompt delivery	26.50 to 27.50		27.00 to 28.00	
Future	26.00 to 27.00		26.00 to 27.00	

OLD METALS.

Heavy copper and wire	16.00	16.50
Brass, heavy	10.00	9.75
Brass, light	8.50	8.50
Lead, heavy	4.75	4.75
Zinc, scrap	6.12½	6.12½

COPPER EXPORTS IN OCTOBER.

Total tons, week ending	Oct. 22, 13,896	Oct. 29, 21,453

INDUSTRIAL SECURITIES

Security.	Capital Stock Listed.	Dividend. Per Cent.	Dividend. Period.	Quotation. Oct. 23.	Quotation. Oct. 30.
Allis-Chalmers, pf.	$2,083,800	.....	.....	1*	2
Allis-Chalmers, 2d assess. paid	17,151,100	.....	.....	2⅞	2⅞
Allis-Chalmers, pf., 2d assess. paid	14,034,700	.....	.....	8½*	7½
Amalgamated Copper	153,887,900	1	Q	86⅜	83⅜*
American Tel. & Tel.	334,712,300	2	Q	143	142½
Crocker-Wheeler, c.	1,700,000	1½	Q	87*	86*
Crocker-Wheeler, pf.	500,000	1½	Q	104*	105*
Electric Storage Battery, c.	16,074,425	.....	.....	55¾	55
General Electric	77,726,700	2	Q	180½	180
Mackay Cos., c.	41,380,400	1½	Q	86½*	80
Mackay Cos., pf.	50,000,000	1	Q	68*	67½
Western Union Tel.	79,943,400	¾	Q	79⅜	79⅛
Westinghouse, E. & M., c.	31,685,300	1	Q	82½	82½
Westinghouse, E. & M., pf.	3,998,700	1¾	Q	126*	125

*Last price quoted.

ELECTRIC SECURITIES

Q—Quarterly. M—Monthly. S—Semi-annually. A—Annually.

Security.	Outstanding.	Dividend. Per Cent.	Dividend. Period.	Last Quotation. Bid.	Last Quotation. Asked
Adirondack Electric Power, c.	$9,500,000	.....	.....	24½	25
Adirondack Elec. Power, pf.	2,500,000	.....	.....	67½	68½
Amer. Gas & Electric ($50), c.	2,500,000	1¾	Q	89	91
Amer. Gas & Electric ($50), pf.	1,537,500	1½	Q	48	50
Amer. Light & Traction, c.	10,395,400	2½	Q	432	435
Amer. Light & Traction, pf.	14,236,200	1½	Q	109	110½
Amer. Power & Light, c.	5,631,400	.....	.....	69	70
Amer. Pwr. & Lt., 6% cum pf.	3,106,800	1½	Q	85¾	86
Amer. Pwr. & Lt., opt. warr.	1,604,000	.....	.....	13	15
Amer. Pwr. & Lt., 6% notes, '21	2,199,100	3	S	97½	99½
Appalachian Power, c.	6,000,000	.....	.....	25½	26
Appalachian Power, pf.	2,180,000	.....	.....	74½	75½
Arizona Power, c.	3,000,000	.....	.....	10	15
Arizona Power, pf.	850,000	.....	.....	50	55
Asheville Light & Power, 1st s. f. 5s, '42	1,100,000	2½	S	93	96
Augusta-Aiken Railway & Electric, s. f. 5s, '35.	2,588,000	2½	S	90	95
Augusta-Aiken Ry. & Elec., c.	2,250,000	1½	.....	25	35
Augusta-Aiken Ry. & Elec., pf.	1,500,000	1½	Q	75	85
Augusta Railway & Electric, 1st 5s, '40	967,000	5	A	100	....
Butte Electric & Power, c.	4,037,000	1¾	Q	175	176
Butte Electric & Power, pf.	1,000,000	1¼	Q	83	85
Butte Elec. & Pwr., 1st 5s, '51.	4,283,000	2½	S	95	97½
Central Maine Power; 1st 5s.	1,923,000	5	A	97	99
Cities Service, c.	5,499,430	½	M	122	122
Cities Service, pf.	10,195,360	½	M	89	91
Columbus Railway Gas & Electric, 1st 5s, '36.	2,454,000	2½	S	94	95
Columbus Ry. G. & Elec., c.	2,000,000	.....	.....	60	....
Columbus Ry. G. & Elec., pf.	840,000	1½	Q	85	95
Commonwealth Edison, cap. stock	32,964,800	7	A	144	146
Consolidated Gas, Electric & Power (Baltimore), 4½s.	11,564,000	2½	S	88¼	88¾
Consum. Pwr. (Mich.), 5s, '36	8,407,000	2½	S	96	98
Consumers Power (Minn.), 1st 5s, '29	9,539,500	2½	S	89½	92
Dallas Elec. Corp., 5s, '22.	3,659,000	2½	S	95	98
Denver Gas & El. Lt., c.	7,001,300	¼	M	220	....
Denver Gas & El. Lt., gen. 5s,	6,000,300	2½	S	95	97
Empire District Electric, 5s.	1,925,000	2½	S	87	88
Edison El. Ill. of Boston, cap. stock	15,603,700	2½	Q	273½	....
Federal Light & Traction, c.	4,750,000	.....	.....	37	37½
Federal Light & Traction, pf.	2,500,000	1½	Q	84	85
Kings County El. Lt. & Pwr.	10,000,000	2	Q	130	132
Niagara Falls Power, 5s, '32.	10,000,000	2½	S	101¼	102
Northern Ohio Railway & Light, 4½s, '35	17,544,000	2¼	S	86	87½
Northern States Power, c.	5,975,000	.....	.....	29	30
Northern States Power, pf.	8,386,700	1¾	Q	88	90
Pacific Gas & Electric, c.	31,908,750	1¼	Q	64⅜	64¾
Pacific Gas & Electric, gen. and ref. 5s, '42	20,000,000	2½	S	91	91
Pacific Gas & Electric, pf.	10,000,000	1½	Q	93	94
Philadelphia Electric ($25).	24,987,750	1½	Q	23	23⅛
Portland General Electric, 5s.	8,000,000	2½	S	100½	102½
Republic Railway & Light, c.	5,200,000	.....	.....	27	28
Republic Railway & Light, pf.	6,360,000	1½	Q	82½	82¾
St. Joseph's R., L. H. & P., 5s.	4,637,000	2½	S	99	100
Seattle Electric Co., con. 5s, '29	7,417,000	2½	S	98	100
Southern Calif. Edison, 5s, '39	9,975,000	2½	S	96	98
Southern Power, 5s.	4,000,000	2½	S	100	101
Standard Gas & Elec. ($50), c.	9,343,150	.....	.....	$23	$24
Standard G. & Elec. ($50), pf.	10,977,950	2	Q	$50½	$51
Tennessee R., L. & Pwr., c.	20,000,000	.....	.....	24½	24¾
Tennessee R., L. & Pwr., pf.	10,250,000	1½	Q	78¼	79
Tri-City Railway & Light, c.	9,000,000	.....	.....	57	60
Tri-City Railway & Light, pf.	2,826,200	1½	Q	93	95
Tri-City Ry. & Lt., 5s, '23.	8,207,000	2½	S	97¾	....
Western Power.	14,670,000	.....	.....	26½	28¼
Western Power, 6% cum. pf.	6,000,000	6	.....	56½	59

Personal

Mr. R. B. Candage has been appointed auditor of the Western States Gas & Electric Company, Stockton, Cal., to succeed Mr. B. F. Wellington, resigned.

Mr. Frank Hildreth has been appointed manager of the new-business department of the Northern Idaho & Montana Power Company at Kalispell, Mont., succeeding Mr. A. P. Tills.

Mr. Thomas Clark has resigned from the Green Bay (Wis.) Gas & Electric Company and joined the forces of the Lake Shore Consolidated Gas Company at Highland Park, Ill.

Mr. J. L. Herbst, of Dayton, Ohio, will on Nov. 15 assume the position of superintendent of the Municipal Electric Light & Water Works, of Butler, Ind., succeeding Mr. J. S. Norford.

Mr. R. M. Searle, third vice-president of the Rochester (N. Y.) Railway & Light Company, was elected a member of the Council of the American Gas Institute at its recent annual meeting.

Mr. E. K. Hall, legislative counsel of the New England Telephone & Telegraph Company, Boston, Mass., has been elected vice-president, to perform such duties as may be assigned to him by the president.

Mr. W. C. Duncan, contract agent for the Lawrence (Kan.) Railway & Light Company, addressed the Kansas State University Branch, A. I. E. E., Oct. 16, on the subject of "Commercialism in Engineering."

Mr. Anson W. Burchard, of the General Electric Company, is at present in London, England, on business in connection with the company. It is not unlikely that Mr. Burchard will be abroad for over a month.

Mr. B. F. Wellington, who for twenty-four years has been associated with the gas and electric interests of Stockton, Cal., has resigned from the Western Gas & Electric Company and is retiring from active business life.

Mr. Clare N. Stannard, secretary and contract agent of the Denver (Col.) Gas & Electric Company, was elected second vice-president of the American Gas Institute at its seventh annual meeting in Atlantic City, N. J., on Oct. 17.

Mr. Emil Rathenau, founder of the German Edison company and general manager of the Allgemeine Elektricitäts Gesellschaft, Berlin, who had suffered for a considerable time with a diseased leg, has been compelled to have the leg amputated.

Mr. E. B. Smith has been appointed general manager of the American Orr Concrete Pole Company, Anaheim, Cal., by the board of directors of that company. Mr. Smith was formerly connected with the Bell Telephone Company in Los Angeles.

Mr. Ray Flanders has been appointed contract agent for the Bristol Gas & Electric Company of Bristol, Tenn. Mr. Flanders comes to Bristol from the sales staff of the Lincoln (Neb.) Gas & Electric Light Company, another of the Doherty interests.

Mr. T. B. Rhodes has been appointed commercial manager for the Consumers' Electric Light & Power Company, New Orleans, La., succeeding Mr. J. J. Flautt. Mr. Rhodes served in a similar capacity with the Elmira (N. Y.) Water, Light & Railway Company.

Mr. James Riley, formerly electrical and mechanical engineer of the Choctaw Railway & Lighting Company, McAlester, Okla., has become associated with the Missouri, Kansas & Texas Railway as system electrical engineer, with headquarters at Parsons, Kan.

Mr. George Decker, for many years foreman of shops of the Southern California Edison Company, Los Angeles, Cal., has been promoted to the position of assistant superintendent of transmission. In his new office Mr. Decker will have charge of all substations.

Mr. A. P. Tills, formerly contract agent of the Northern Idaho & Montana Power Company at Kalispell, Mont., has been transferred to Eugene, Ore., where he will be assistant to Mr. R. M. Jennings, manager of the Oregon Power Company, at the latter place.

Mr. R. J. Graf, of Chicago, has been appointed secretary of the Louisville Lighting Company and the Louisville Gas Company, of Louisville, Ky., two companies controlled by H. M. Byllesby & Company, Chicago. **Mr. M. A. Morrison** will become assistant secretary of these companies.

Mr. Frank P. Woy, who for the past ten months has been general manager of the Trinidad Electric Transmission, Railway & Gas Company, Trinidad, Col., has recently resigned from that company and will go to Albuquerque, N. M., to take a rest before returning to business again.

Mr. Herbert Lutz, who for the past twenty years has been in charge of the meter department of the Dominion Power & Transmission Company, Hamilton, Ont., has been appointed to the government position of inspector of gas and electricity, until recently occupied by Mr. Donald McPhie.

Mr. F. P. Wood, who at one time was connected with the Black Hills Traction Company, Deadwood, S. D., and later with the Southern Colorado Railway, Light & Power Company, has succeeded Mr. F. P. Woy as manager of the Trinidad Electric Transmission, Railway & Gas Company, Trinidad, Col.

Mr. C. O. Mailloux, consulting engineer of New York, has been appointed assistant to President W. H. Nichols, of the Granby Consolidated Mining, Smelting & Power Company, Ltd. This company owns immense tracts of mining lands in British Columbia and is one of the largest copper producers in the country.

Mr. W. N. Warburton, of the Toronto, Hamilton & Buffalo Railway, Hamilton, Ont., Can., has been appointed general manager of the Lake Erie Railway & Transportation Company, London, Ont., to succeed Mr. S. W. Mower. Mr. Warburton was at one time connected with the Chatham, Wallaceburg & Lake Erie Railway.

Mr. Herbert C. Goodwin, engineer of the power station of the Willimantic (Conn.) Gas & Electric Light Company, has recently become assistant superintendent of the New Britain Gas Company. When he left he was presented with a gift of money from the Willimantic company and a handsome memorial from his fellow employees.

Mr. Alton W. Leonard has been appointed district manager of the Stone & Webster properties in the Puget Sound district, to succeed the late Richard T. Laffin. Mr. Leonard has had charge of Stone & Webster properties in Brockton, Mass.; Houghton, Mich., and Minneapolis, Minn. Until recently he was district manager of the properties of the Stone & Webster Management Association in the Middle West.

Mr. Henry L. Doherty has now been connected with the gas industry thirty years, and in order to commemorate the thirtieth anniversary of his employment as an office boy by the Columbus (Ohio) Gas Light Company his associates surprised him at the regular weekly dinner and business discussion held at Fraunces' Tavern, New York City, Oct. 21, by departing from routine business in order to celebrate the event appropriately.

Mr. John Sanders, who has been appointed general manager of the Danbury & Bethel Street Railway, Danbury, Conn., and has also been elected a director of the company, was formerly connected with the General Electric Company at Schenectady, N. Y., and until recently was in charge of the work of improving the generating plant of the company with which he is now associated. During its construction he was also connected with the Shore Line Electric Railway of New Haven, Conn.

Mr. Godfrey H. Atkin, the newly elected president of the Railway Electric Supply Manufacturers' Association, has been connected with electrical business in the West since 1890, when he joined the Chicago office of the Thomson-Houston Electric Company, afterward merged into the General Electric Company. He has been identified with the Electric Storage Battery Company since 1902 and is manager of the Chicago office of that company. He is vice-chairman of the Chicago Section of the Electric Vehicle Association and a member of the following clubs: Midday, South Shore Country, Chicago Athletic, Evanston Yacht, Chicago Yacht, and Royal Canadian Yacht Club of Toronto, Can. Mr. Atkin's favorite pastime is yachting and

he is the owner and skipper of the schooner *Nomad*. He is one of the best known of the electrical men of Chicago.

Mr. F. C. Kaulback is resident chief engineer of construction of the hydroelectric plants of the Appalachian Power Company, with headquarters at Bluefield, W. Va. The general superintendent of construction, in full charge of work on the spillway dams, retaining dams, power houses, transformer stations, etc., is **Mr. A. L. Felio. Mr. H. E. Shedd** is superintendent of power, having charge of the operation of the nearly completed developments. In our issue of Oct. 12 it was erroneously stated that **Mr. D. E. Clough** was in charge of the construction of the two stations and that Mr. Shedd was general superintendent.

Mr. Thomas E. Murray, second vice-president and general manager of the New York Edison Company, to whom was recently issued a patent on a portable electric bath, has the distinction of having had more than 155 patents granted to him, about 150 of which relate to electrical apparatus and appliances. His work has by no means been confined to inventions, however, and he is probably best known as one of the leaders in the electric-lighting industry, with which he has been long connected. Born at Albany, N. Y., Oct. 21, 1860, he grew up in that city and very early in life manifested a leaning to mechanical pursuits. His first responsible position was that of engineer of the Albany Water Works. Shortly afterward (twenty-six years ago) he was made chief engineer of the Electric Illuminating Company of Albany. His superiors, recognizing his worth, made him general manager of the company and also permitted him to act in a consulting capacity for the railway and lighting properties of Albany and Troy. Mr. A. N. Brady then brought him to New York to effect the physical merger of the electric-lighting systems of Brooklyn, and about fifteen years ago Mr. Murray took up his permanent residence in New York City. To him the Brady interests also intrusted the task of the physical consolidation of the electric-lighting properties in Manhattan. In this work, and in fact in all work on properties in which Mr. Brady was interested, Mr. Murray's engineering judgment was in demand. The steam plants in Albany, Troy, Rochester and Utica were designed under his supervision, and the Waterside stations of the New York Edison Company, the newer stations of the Brooklyn Rapid Transit Company and the Gold Street station of the Kings County Electric Light & Power Company are monuments of his skill as a designing engineer. Mr. Murray is at present engaged in work on the new steam-turbine station of the United Electric Light & Power Company on 201st Street, New York City, and on the hydroelectric station of the Chattanooga & Tennessee River Power Company at Hales Bar, 18 miles from Chattanooga, Tenn. Besides his connection with the New York Edison Company, Mr. Murray is a director in the Broolyn Edison company, vice-president and director of the United Electric Light & Power Company, president and director of the Yonkers Electric Light & Power Company, director in the Louisville Lighting Company, director in the Westchester Lighting Company, vice-president and director of the Consolidated Telegraph & Electrical Subway Company and connected with other public utilities. He is also the leading spirit in the Metropolitan Engineering Company, of Brooklyn. It is almost impossible for friends of Mr. Murray to think of him without recalling his happy family life, for he is the proud father of four boys and four girls. His chief recreation is music, of which he is passionately fond. Mr. Murray is a member of the A. I. E. E., the A. S. M. E., the N. E. L. A. and of the Association of Edison Illuminating Companies, of which body he has twice been elected as president.

THOMAS E. MURRAY.

Mr. Raymond H. Smith has been appointed manager of the Jackson (Miss.) Light & Traction Company, one of the American Public Utility Company's properties. Mr. Smith from 1897 to 1900 occupied various positions with the Waterbury (Conn.) Traction Company. During the latter year, when the Waterbury company was absorbed by the Connecticut Railway & Lighting Company, he was transferred from the transportation department of the Waterbury company to the headquarters of the Connecticut Railway & Lighting Company at Bridgeport, as purchasing agent and secretary to the general manager. In 1903, after occupying the position of superintendent of transportation, he was appointed superintendent with jurisdiction extending to the repair shops and power plants. In August, 1907, he became general manager of the Albany & Hudson Railroad, which operated the high-speed, third-rail system from Albany to Hudson as well as the local trolley service in the latter place and furnished electrical energy for lighting at Rensselaer, Hudson and intermediate towns. In July, 1909, he became receiver of the Albany & Hudson Railroad company, and a few months later was appointed general manager of this company's successor, the Albany Southern Railroad Company.

Obituary

Mr. John W. Killian, who may be remembered by older electrical men as foreman of the arc-lamp and fan-motor manufacturing departments of the Western Electric Company in Chicago some years ago, died in the Henrotin Memorial Hospital in Chicago on Oct. 24, aged seventy-one years. He was born in Germany, but came to this country as a boy and served as a soldier in the United States Army during the civil war. For a long term of years Mr. Killian was employed by the Western Electric Company, but he retired in 1897. He was a member of the G. A. R.

Mr. Charles Cushing Badeau, who for many years had been connected with the electrical industry as an engineer in the manufacture of circuit-breakers, oil switches and switchboards, died Oct. 16 at his home in Winthrop, Mass. At the time of his death Mr. Badeau was thirty-seven years old, he having been born in Brooklyn, N. Y., Nov. 16, 1875. Mr. Badeau started with Mr. C. S. Van Nuis in 1892, designing and manufacturing circuit-breakers, switchboards, etc. Later he was connected with the General Electric Company in the drafting department and as a designer of switching apparatus, superintending the installation of many large equipments. About 1901 he left the General Electric Company and entered the employ of the Wagner Electric & Manufacturing Company, of St. Louis, Mo., where he had charge of the alternating-current switchboard department. For a while Mr. Badeau was also associated with the Cutler-Hammer Manufacturing Company in the design, construction, installation and operation of circuit-breaking devices. At the time of his death Mr. Badeau was chief engineer for the Condit Electrical Manufacturing Company, of Boston, having charge of its engineering work including the design of circuit-breakers, oil switches and switchboard apparatus of all kinds. He was also the electrical expert of the company's patent department. Mr. Badeau, who was a Jovian and an associate of the A. I. E. E., was the author of several papers on subjects pertaining to his specialty and at the recent convention of the New England Branch of the N. E. L. A. submitted a paper on "Eectric Protective Devices." He was regarded as a man of unusually high character and ability and his loss is keenly felt by his friends and business associates.

CHARLES C. BADEAU.

Construction

MARIANNA, ARK.—E. C. and J. S. Horner, of Memphis, Tenn., have purchased the property of the Marianna Lt. & Pwr. Co. The new owners contemplate improvements to the plants and also the construction of an electric railway to connect Marianna with the North Arkansas Railroad and which may possibly be extended to Memphis.

BAIRDSTOWN, CAL.—The citizens of Bairdstown have voted to install an ornamental street-lighting system, including Huntington Drive. The latter will form part of the "lighted way" which is to connect all the municipalities in the San Gabriel Valley.

BEAUMONT, CAL.—The Southern California Edison Co. is planning to erect a transmission line from Redlands to Beaumont, a distance of about 15 miles, to distribute electricity for lamps and motors.

CRESCENT CITY, CAL.—The Mountain Pwr. Co. has applied to the Railroad Commission for a certificate of public convenience and necessity to construct an electric plant in Cresent City and to operate in Del Norte County.

DUNSMUIR, CAL.—The citizens are planning to install an ornamental street-lighting system on several of the streets here.

ESCONDIDO, CAL.—The Mutual Water Co. is planning to install a power plant to use the water from its impounding reservoir, 7 miles from Escondido. The installation of a 2000-hp plant is contemplated and a steam auxiliary plant may be installed later.

LONG BEACH, CAL.—The utilities committee appointed by the Council to formulate a plan to bond the city for needed improvements has adopted a resolution recommending a total outlay of $1,200,000, of which $100,000 is recommended for the installation of a municipal electric-light plant.

LOS ANGELES, CAL.—The Los Angeles Ry. Corpn. has purchased franchises on Dayton Avenue and South Main Street in Los Angeles.

MARYSVILLE, CAL.—The Marysville & Nevada Pwr. Co. is asking bids for the construction of a tunnel just below Goodyear Bar, near Downieville, in connection with its power plant and irrigation project. It is expected to have the tunnel completed by spring, when a diversion dam will be constructed as well as a small amount of flume and ditch to carry the water to the power-house site. The water is to be used for irrigation purposes. James O'Brien, of Smartsville; Jason Meek and J. E. Ellert, of Marysville, are interested.

REDDING, CAL.—The Mount Shasta Pwr. Co. is installing a small power plant in the Big Bend of Pitt River, to operate compressors in connection with air drills in the tunnels now started. One tunnel is to be 7 miles long.

RIVERSIDE, CAL.—The State Railroad Commission has granted the Southern Pacific Co. permission to purchase the street-railway franchises in the city of Richmond held by John H. Nicholl and H. C. Cutting. These franchises will be used in the interurban system contemplated by the Southern Pacific Co. to connect Richmond with Berkeley, Oakland and Alameda.

SAN FRANCISCO, CAL.—The Stone & Webster Engineering Corpn., of Boston, Mass., it is reported, is planning to install a power plant, using the overflow of Lake Tahoe for the prime mover. The name of the operating company is withheld.

SANTA MONICA, CAL.—The city of Santa Monica is planning to install an ornamental street-lighting system on several streets.

TROPICO, CAL.—The State Railroad Commission has granted the Pacific Lt. & Pwr. Corpn., of Los Angeles, permission to purchase the distributing system of the Glendale Lt. & Pwr. Co. in Tropico for $5,200.

TULARE, CAL.—Capitalists of Lindsay and Tulare are planning to connect Tulare, Lindsay and Porterville in the near future by an electric railway 25 miles long.

VENTURA, CAL.—Sealed bids will be received by J. B. McCloskey, of the Board of Supervisors of Ventura County, Ventura, until Nov. 7 for the installation of electric fixtures and of vault door and lining in the proposed court house to be erected on Poli Street in the city of San Buenaventura. Plans and specifications may be seen at the above office and the office of Albert C. Martin, 430 Higgins Building, Los Angeles, copies of which may be obtained at the office of the architect upon deposit of $10, which will be refunded upon return of same.

DENVER, COL.—Contracts have been signed between the Central Colorado Pwr. Co. and the Denver City Tramway Co. whereby the former will supply electricity from its hydroelectric plants to the Denver Tramway Co. about Jan. 1. Generators and other machinery to cost approximately $50,000 will be installed either at the power house of the tramway company or at the substation on the Denver & Intermountain R. R. Co. to transform the energy from alternating current to direct current for use by the tramway company. Arrangements are being made by the Central Colorado Pwr. Co. for doubling the generating capacity of its Shoshone plant and the erection of additional transmission lines to Colorado Springs and other towns.

DALTON, GA.—A contract has been entered into between the City Council and the Georgia Ry. & Pwr. Co. whereby the latter will supply power to the city. The company will be granted a franchise immediately to extend its lines into Dalton.

GRANTVILLE, GA.—The City Council has awarded the J. B. McCrary Co., of Atlanta, the contract for the installation of an electric-light system here.

EASTPORT, IDAHO.—Plans are being prepared for the installation of an electric-light plant for the Copper Falls Mining Co. here. The proposed plant will supply electricity for lighting the town. J. W. McBride, mining expert, has charge.

IDAHO FALLS, IDAHO.—The proposition to issue $35,000 in bonds to complete the hydroelectric plant will be submitted to a vote on Nov. 19.

BETHANY, ILL.—The Village Board has granted the Central Illinois Pub. Service Co., of Mattoon, a 50-year franchise to install and operate an electrical distributing system in this village. A contract for lighting the streets for a period of five years has been closed. A transmission line will be erected from Mattoon, a distance of 23 miles.

CAMP POINT, ILL.—The property of the Camp Point El. Lt. & Pwr. Co. has been purchased by the Middle West Utilities Co., of Chicago, for $12,000.

CARLINVILLE, ILL.—The Macoupin County Tel. Co. is planning to place its wires underground in the business district.

CHICAGO, ILL.—Proposals will be received by the city of Chicago until Nov. 7, Room 406, City Hall, Chicago, Ill., for furnishing and erecting one electrically operated 15-ton Gantry crane at the Fourteenth Street pumping station, 1352 Indiana Avenue, Chicago. The crane runways will be furnished by the city. The crane is to be operated by 220-volt direct current. Plans and specifications are on file at the office of the Department of Public Works, Room 406, City Hall. L. E. McGann is commissioner of public works.

DECATUR, ILL.—A contract has been closed between the Wabash R. R. Co. and the Decatur Ry. & Lt. Co. whereby the latter will furnish energy to operate the machinery in the new railroad shops of the company.

GALESBURG, ILL.—The Rock Island Southern R. R. Co. has applied to the City Council for permission to build an electric railway on several streets in Galesburg.

GALESBURG, ILL.—Application has been made to the City Council by Weinberg Brothers for a franchise to supply electricity and steam and hot-water heat on certain streets of the city. The power will be supplied from their cold-storage plant.

HILLSBORO, ILL.—The City Council has awarded the Hillsboro El. Lt. & Pwr. Co. a contract to supply electricity for the municipal water-pumping station.

HILLSBORO, ILL.—The Chicago, Cleveland, Cincinnati & St. Louis R. R. Co. has closed a contract with the Hillsboro El. Lt. & Pwr. Co. whereby the latter will supply the railroad company with electricity for the coal docks and roundhouses to operate turntables, for driving machinery in machine shops, for lighting switch lamps and for illuminating the yards, which are 2 miles long.

MATHERSVILLE, ILL.—Preparations are being made for the installation of an electric-light system here. Electricity for operating the system will be supplied by the Rock Island Southern Ry. Co., of Rock Island.

MORRISONVILLE, ILL.—The property of the Morrisonville El. Co. has been purchased by the Hillsboro El. Lt. & Pwr. Co. It is proposed to extend the transmission line from Harvel to supply the service here.

PARIS, ILL.—The Central Illinois Pub. Serv. Co., it is reported, is planning to build a large power plant here, to cost about $200,000. Electricity for lamps and motors will be supplied to towns in the vicinity of Paris.

RAYMOND, ILL.—The Town Board is contemplating the installation of a new street-lighting system when the present contract expires next year. The Hillsboro El. Lt. & Pwr. Co. holds the present contract.

SANDWICH, ILL.—The municipal electric-light plant has been purchased by the Illinois Northern Utilities Co. for $18,000. The Council has granted the company a 50-year franchise. The pole lines will be entirely rebuilt. For the present electricity for operating the system will be supplied from the Mendota plant, but ultimately from the Lockport, Dixon and Oregon stations. The present arc-lamp street-lighting system will be changed to 40-watt tungsten lamps, with three and four-lamp clusters for the business district. The city has contracted with the company for power for pumping the city water.

SPRINGFIELD, ILL.—Isaac A. Smith, of the Springfield & Central Illinois Interurban Co. has notified the city commission that he will ask for an independent franchise to the city for an interurban line to be built from St. Louis to Springfield, via Hillsboro and Pawnee.

SPRINGFIELD, ILL.—Sealed bids will be received by the Board of Administration, Springfield, until Nov. 11, for equipment necessary to change power for the factory from steam to electrically driven machinery, to be installed at the Illinois Industrial Home for the Blind, Marshall Boulevard and Nineteenth Street, Chicago. Plans and specifications may be obtained upon application to Frank D. Whipp, fiscal supervisor, Springfield.

STERLING, ILL.—The Illinois Northern Utilities Co., of Chicago, is contemplating the erection of a transmission line between Sterling and Prophetstown, which will also supply electricity to rural districts.

INDIANAPOLIS, IND.—The Board of Public Works has instructed the Indianapolis Lt. & Ht. Co. to install electric lamps on a large number of streets which heretofore have been lighted with gas lamps.

LA PORTE, IND.—The Northern Indiana Trac. Co. is said to be contemplating the construction of an interurban railway from La Porte to Knox by way of Bass Lake.

MONTPELIER, IND.—The Town Board is reported to be negotiating with the Muncie El. Lt. Co., Muncie, to extend its transmission lines to Montpelier. The local plant, now in litigation, does not give satisfactory service.

MOORESVILLE, IND.—The Mooresville Utilities Co. has acquired the properties of the Mooresville Wtr., Lt., Ht. & Pwr. Co., the Public Service Co. and the Arctic Ice Co. The new company proposes to change the equipment from direct current to alternating current and is in the market for generators, transformers, meters, poles, wire, etc. C. C. Cordon is manager.

ROCHESTER, IND.—The City Council has instructed C. A. Davis, superintendent, and J. C. Parker, chief engineer, to purchase a new engine and other equipment for the municipal light and power plant.

SOUTH BEND, IND.—The Board of Public Works is asking for bids for lighting the city with electricity. The present contract, which cost about $50,000 per year, will expire in two years. This is deemed excessive, and it is estimated that the service can be furnished at a much lower cost by a municipal plant.

ALTOONA, IA.—The Council has granted George T. Gibson a franchise to install an electric-light plant here.

CEDAR FALLS, IA.—The City Council has asked the Citizens' Gas & El. Co. to place a price on its property and to make an estimate of cost of operating the system. The company has also been asked to submit a proposal for contract for lighting the streets for a term of years. The Council has recently secured estimates on the cost of installing and operating a municipal electric-light plant.

FREDERICKSBURG, IA.—The proposition to issue $4,500 in bonds for the installation of an electric-light plant will soon be submitted to a vote.

GREENFIELD, IA.—At an election held Oct. 21 the proposition to issue $9,000 in bonds for improvements to the municipal electric-light plant was carried. It is proposed to change the system from direct to alternating current. M. G. McCreight is town clerk.

HEDRICK, IA.—At a special election held recently the proposition to grant the New Sigourney El. Lt. & Pwr. Co., Sigourney, a franchise to extend its transmission lines to Hedrick was carried.

INWOOD, IA.—The proposition to grant a franchise to the Sioux Valley Pwr. Co. to supply electricity in Inwood will be submitted to the voters on Nov. 5.

MANSON, IA.—Plans are being considered for remodeling the local electric-light plant. For further information address R. R. Healey.

SCRANTON, IA.—The proposition to grant an electric-light franchise to A. Moorhouse and others will be submitted to a vote on Nov. 5.

SHELDAHL, IA.—At an election held recently the proposition to grant the Boone El. Co. a franchise in Sheldahl was carried.

SIOUX RAPIDS, IA.—The controlling interest in the Sioux Rapids Flour & El. Pwr. Co. has been purchased by W. H. Grover, of Ames, Ia., and G. Lundgren, of Cherokee, Ia. The new owners propose to improve the dam in order to secure more power for the plant.

WINTHROP, IA.—Herman Jaeger, of Dyersville, Ia., has submitted a proposition to the town offering to install an electric-light plant in connection with the water-works.

PRATT, KAN.—The contract for installing power and heating plant and water supply on the grounds of the Fish and Game Hatchery has been awarded to the Salina Plumbing Co., Salina, for $6,719.

CLAY, KY.—The Public Service Co. is planning to erect an electric-light plant in Clay.

HENDERSON, KY.—Leslie P. Hite, superintendent of the municipal electric-light plant, states that improvements involving an expenditure of about $25,000 are necessary to put the plant in shape to meet the demands made upon it.

LOUISVILLE, KY.—The Louisville Ltg. Co. contemplates extending its transmission lines to St. Helen's, several miles south on the Eighteenth Street road.

LOUISVILLE, KY.—A movement has been started to erect and maintain ornamental street lamps on Main Street from First to Eighth Street. Jacob Greenberg, proprietor of the Galt House, Louisville, is in charge of the project.

NEWPORT, KY.—The city is planning the installation of boulevard lamps mounted on ornamental bronze standards along the York Street Boulevard.

OWENSBORO, KY.—Plans are being prepared for the installation of ornamental bronze lamp standards on Main and Fredericka Streets.

NEW ORLEANS, LA.—The Louisiana Interstate Mineral Co. has been organized here by Northern capitalists to work and develop their holdings in Smith and Jasper Counties, Mississippi. The company is capitalized at $3,000,000 and holds over 15,000 acres of timber land, rich in mineral deposits, near Laurel, Miss. Several factories will be erected at once; also a fertilizer plant capable of producing 5000 tons per day. A large dam will be constructed and a power plant installed capable of developing 10,000 hp, which will furnish electricity for the entire project and to surrounding towns. C. F. Peterson, formerly of New York, N. Y., is president; A. F. Peterson, of Rew, Pa., is vice-president; Clarence L. Foretich, of Mobile, Ala., secretary, and T. Bernard Burke, of Eau Claire, Wis., treasurer.

MOUNT WASHINGTON, MD.—The Baltimore County Commissioners have purchased the disposal plant of the Baltimore Suburban Sewerage Co. at Mount Washington, with land, appurtenances, etc., for $600,000. The disposal plant is to be used as the nucleus of a sewerage system for the Jones Falls Valley, which is to be drained through the aid of an electrically driven pump.

CORUNNA, MICH.—The proposition to grant the Consumers' Pwr. Co., of Corunna, a 30-year franchise will be submitted to the voters on Nov. 5. Under the terms of the franchise the company agrees to rebuild its entire system in Corunna, the work to be completed within eight months.

DETROIT, MICH.—The public lighting commission has begun work on the installation of approximately 1200 arc lamps, which will double the number of lamps now used in the main thoroughfares of the city. The commission hopes to get an appropriation to extend the improved lighting system to the city limits on Woodward Avenue next year.

FLINT, MICH.—Application has been made to the Board of County Supervisors for an appropriation of funds to provide electricity for lamps and motors at the county farm. The cost of the work is estimated at from $1,500 to $2,000. The Flint El. Co. has offered to extend its lines from Seventh Street to the county farm.

FRANKFORT, MICH.—The Betsey River Pwr. Co. contemplates building a dam giving a 26-ft. head and developing 1200 hp from a reservoir covering about 250 acres of back-water land already owned by the company. Eugene Zimmerman, of Cincinnati, Ohio, is said to be interested in the company.

HOLLAND, MICH.—The Holland Merchants' Association has indorsed the boulevard lighting system, which will extend from the Père Marquette depot to the city hall.

IRON RIVER, MICH.—Work has begun on the substation of the Menominee Range Pwr. & Devel. Co. in Iron River.

KALAMAZOO, MICH.—The city is planning to install an ornamental street-lighting system. Eight ornamental standards are now being erected on Main Street for experimental purposes.

LEXINGTON, MICH.—The City Council has decided to call an election soon to vote on the proposition to grant franchises to install an electric light and power plant and street-railway system in Lexington. David Oppenheim, of Detroit, is interested.

MONROE, MICH.—Arrangements have been made for the installation of a new lighting system on Monroe Street, to be maintained by underground wires. Jacob Martin is chairman of the committee in charge of the work.

MUSKEGON, MICH.—The Brunswick-Balke-Collender Co. is rebuilding its power plant, plans for which were prepared by Robinson & Campau, of Grand Rapids.

PINCONNING, MICH.—The installation of a new street-lighting system is under consideration, electricity for the same to be supplied by the Jennings stave mill.

SEBEWAING, MICH.—A special election will soon be held to vote on the proposition to issue $5,000 in bonds for improvements to the municipal electric-light plant.

BRAINERD, MINN.—The Minneapolis Steel & Machinery Co., Minneapolis, it is reported, has submitted a proposition to the Council offering to take over the municipal electric-light plant and install new machinery.

HIBBING, MINN.—The new suburb of Kittzville is contemplating the installation of an electric-light system and would like to secure electrical service from the municipal electric plant in Hibbing.

HUTCHINSON, MINN.—The Hutchinson Ltg. & Mfg. Co. has submitted a proposition to the Council for the installation of cluster-lamp system on Main Street.

PRINCETON, MINN.—The Blue Hill Rural Tel. Co. is planning to build a telephone system in Millelacs and Sherburne Counties. About 25 miles of line will be erected.

ROYALTON, MINN.—A deal has been closed between the Royalton Lt. & Pwr. Co. and the Little Falls Wtr. Pwr. Co., Little Falls, whereby the latter will supply energy to operate the system of the Royalton company. Work will begin on construction of the transmission line at once. As soon as the line is completed a 24-hour service will be established.

ST. PETER, MINN.—The City Council contemplates the installation of an ornamental street-lighting system on Minnesota Avenue; also erecting new wire for the municipal street-lighting system.

TONKA BAY, MINN.—A franchise has been granted to the Northern Pwr. Co. to establish an electric-light plant here.

ST. LOUIS, MO.—The Century El. Co. has purchased a site at the corner of Nineteenth and Pine Streets, on which it proposes to erect a seven-story fireproof building at a cost of $150,000.

ST. LOUIS, MO.—Plans have been perfected by the Suburban El. Lt. & Pwr. Co. to extend its transmission lines through St. Louis County, northwest and south from St. Louis. Poles have been erected at Florissant, which will receive electrical service in a short time, as well as Merimec Highlands, Manchester, Eureka, Ballwin, Valley Park, Sherman, Glencoe, Ponds, Allentown and towns farther west. These extensions will involve an expenditure of several hundred thousand dollars.

UNION, MO.—The electric plant of the American Lt. & Pwr. Co., Union, has been purchased by Charles S. Ruffner, general manager of the Mississippi River Distributing Co.

OMAHA, NEB.—The Omaha & Council Bluffs St. Ry. Co. contemplates extending its railway to Benson.

SPARKS, NEV.—Bids are being asked by William M. Leffingwell, superintendent of the Nevada Pwr. & Trans. Co., for the construction of dam, flume and power house in connection with the proposed power plant to be located below Sparks.

CAMDEN, N. J.—Plans for the proposed municipal electric-light plant have been submitted to the special committee of the Council by Runyon & Carey, of Newark, consulting engineers. The plans provide for a power house 80 ft. x 80 ft., the equipment to consist of three 500-kw turbine generators and water-tube boilers equipped with automatic stokers, and the installation of 1200 arc lamps for street lighting to be maintained by underground wires. About 24,500 ft. of wire will be placed underground. Plans have also been outlined for the installation of an ornamental street-lighting system in the business district. The cost of the plant is estimated at about $300,000. It is expected that bids for construction of the plant will be called before the first of the year. James E. Hewitt is president of the City Council.

MORRIS PLAINS, N. J.—The contract for electric wiring of the State Hospital at Morris Plains, N. J., has been awarded to the Beaver Engineering Co., Newark, at $20,500.

NEWARK, N. J.—The Board of Public Utility Commissioners has approved of an issue of $2,750,000 in bonds by the Public Service El. Co., the proceeds to be used for extensions to its plant.

NEWARK, N. J.—The Ironbound Improvement Association is considering the installation of an ornamental lighting system in the Ironbound section. An effort will be made to continue the Market Street lamps from the Pennsylvania Railroad to Hamburg Place.

GALLUP, N. M.—T. A. Fabro and J. M. Mase are contemplating the installation of an electric-light plant here.

GALLUP, N. M.—Plans are being considered by the Gallup El. Lt. Co. for the installation of new equipment in its plant, consisting of a 450-hp Corliss engine connected to a 225-kw, three-phase, 25-cycle alternator, a new heater, a Sterling water-tube heater and necessary feed-water pumps. The company is planning to establish a 24-hour service and to furnish power to Santa Fé railroad. R. B. Ellis, of Los Angeles, Cal., is consulting engineer.

ROSWELL, N. M.—The Roswell Retailers and Business Men's Association has made application to the City Council to change the arc-lamp lighting system on Main Street to boulevard lamps to be erected on both sides of the street. The property owners have agreed to pay the cost of erecting the lamp-posts.

ROSWELL, N. M.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 26, for the installation of an electric passenger elevator in the United States post office and court house, Roswell, in accordance with plans and specifications, copies of which may be obtained at the above office. Oscar Wenderoth is supervising architect.

ALTON, N. Y.—A petition is being circulated among property owners asking for the creation of a lighting district for the village, the service to be furnished by the Northern Wayne Pwr. Co. It is proposed to contract for 20 lamps at $20 each per year.

AUBURN, N. Y.—A contract has been closed whereby the Empire Gas & El. Co. will supply electricity to operate the machinery in the Auburn Button Works and in the new Robinson-Bynom shoe factory. The steam-power plant will be discarded and 15 Westinghouse motors of 10 hp will be installed.

BROOKLYN, N. Y.—Sealed bids will be received by the Board of Health, Department of Health, corner of Centre and Walker Streets, New York, until Nov. 8, for furnishing and installing electrically operated pumps, with automatic controllers and necessary alterations and other work incidental thereto, in the sewer tanks on the grounds of the Kingston Avenue Hospital, borough of Brooklyn. Blank forms and plans for the above work and further information may be obtained at the office of the chief clerk of the Department of Health. Ernst J. Lederle, Ph.D., is president of the board.

BUFFALO, N. Y.—The Cataract Pwr. & Conduit Co. is planning to build an addition to its power plant and transformer station at Babcock and Hanna Streets, Buffalo. Additional equipment will be installed.

BUFFALO, N. Y.—A movement has been started by the business men of Broadway to have the system of lighting recently installed on the streets between Washington and Jefferson Streets extended to the Belt Line.

COOPERSTOWN, N. Y.—The Board of Village Trustees has adopted a resolution to enter into a contract with the Clinton Mills Pwr. Co. for street-lighting for a period of five years. The company agrees to change the arc lamps now in use for incandescent tungsten lamps. It is expected that the substation now being constructed will be completed by Jan. 1.

DOLGEVILLE, N. Y.—Preliminary steps have been taken by the Village Board for installing a new street-lighting system. It is proposed to substitute 100-watt tungsten lamps for the 76 cluster lamps now in use. The Utica Gas & El. Co., of Utica, which holds the street-lighting contract, has offered to bear the expense of changing the system, which is estimated at about $7,000.

JAMESVILLE, N. Y.—The Business Men's Association of Jamesville is considering the question of installing an electric street-lighting system.

NATURAL BRIDGE, N. Y.—Negotiations are under way between the Watertown El. Lt. & Pwr. Co., Watertown, and the St. Lawrence Talc & Asbestos Co., Natural Bridge, whereby the former will supply about 600 hp to operate the plant of the latter in Natural Bridge. Energy will be transmitted from the plant at Carthage, recently purchased by the Watertown company.

NEW YORK, N. Y.—The Public Service Commission has granted the Dry Dock, East Broadway & Battery R. R. Co. permission to equip its street railway in Canal Street between the east side of the Bowery and Centre Street for electrical operation.

NIAGARA, N. Y.—The Business Men's Association has adopted a resolution to engage a hydroelectric engineer to prepare plans and estimates of the cost of the installation of a municipal electric plant.

OSWEGO, N. Y.—The People's Gas & El. Co. is planning extensions to its plant involving an expenditure of about $30,000. The plans provide for an addition to boiler house, installation of a 500-hp boiler and 1000-hp steam turbine and additional generating machinery. R. F. Whitney is manager.

WHITE PLAINS, N. Y.—The Westchester & Northern R. R. Co. has decided to construct its railway through Westchester County at a cost of about from $6,000,000 to $7,000,000. The electric railway will run from White Plains north, through the towns of Harrison, North Castle, Bedford, Roundridge and Lewisboro in Westchester County and through the towns of Greenwich, Ridgefield and Danbury, Conn.

WASHINGTON, N. C.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 23, for the installation complete of an electric passenger elevator in the United States post office and court house, Washington, N. C., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the superintendent of construction. Oscar Wenderoth is supervising architect.

LA MOURE, N. D.—A proposition has been submitted to the Council by S. C. Page, of Sherburne, Minn., for the installation of an electric-light plant here.

NEW ROCKFORD, N. D.—The Council has appointed a committee to secure estimates of cost of installation and maintenance of a municipal electric-light plant.

CIRCLEVILLE, OHIO.—The Public Service Commission has granted the Circleville Lt. & Pwr. Co. permission to issue $75,000 in bonds, of which the proceeds of $46,000 will be used for improvements to the plant.

COLUMBUS, OHIO.—Steps have been taken by the East Side Citizens' Association toward the extension of the ornamental street-lighting system.

LORAIN, OHIO.—The Cleveland, Southwestern & Columbus Ry. Co. has offered to furnish electricity to the city. The company has made no definite proposition as yet. The new power house of the company, located on the outskirts of Elyria, will be completed about the first of the year.

MAUMEE, OHIO.—The Valley Lt. & Pwr. Co., recently incorporated, will take over the plants of the Maumee Valley El. Co. and the Suburban Lt. & Pwr. Co. in Maumee. The plants will be remodeled and energy for operating them will be secured from the Auglaize River power plant at Defiance. The company is capitalized at $200,000. W. P. Wallace, general manager of the Defiance Gas & El. Co., Defiance, is interested in the Valley company.

MOUNT CORY, OHIO.—Steps have been taken for the installation of an electric-light system here, to cost about $1,500.

PIQUA, OHIO.—The plant and holdings of the Miami Lt., Ht. & Pwr. Co., Piqua, have been purchased by the Dayton Pwr. & Lt. Co., Dayton. It is understood that the Dayton company will extend its transmission lines to connect with the local plant. F. M. Tait, of Dayton, is president of the Dayton Pwr. & Lt. Co.

PORT CLINTON, OHIO.—The Northwestern Ohio Ry. & Pwr. Co. has acquired the properties of the Port Clinton El. Lt. & Pwr. Co. and will consolidate it with its other holdings. Electricity for operating the Port Clinton system will be furnished from the central station of the Northwestern company, just east of the city.

SANDUSKY, OHIO.—Owing to the City Council having awarded the Sandusky Gas & El. Co. a contract for street lighting, plans for submitting the proposition to issue $150,000 in bonds for the erection of a municipal electric-light plant have been abandoned.

TOLEDO, OHIO.—Sealed bids will be received by the Board of Park Commissioners until Nov. 8 for furnishing, installing and connecting up an electric-light cable at Bay View Park, according to plans and specifications now on file at the office of the Board of Park Commissioners. F. B. Respess is secretary.

TOLEDO, OHIO.—The Northwestern Ohio Ry. & Pwr. Co., which recently purchased the property of the Toledo, Port Clinton & Lakeside Ry. Co., has been granted permission by the Public Service Commission to issue $193,000 in bonds, to be sold at not less than 85, the proceeds to be used for improvements to the property.

MIAMI, OKLA.—The Greater New York Mining & Development Co., Miami, would like to receive prices on electric-light equipment. Through error this was published under Miami, Fla., in the issue of Oct. 26.

AURORA, ORE.—The Southern Pacific Co. is planning to build an electric railway in this valley this spring.

BURNS, ORE.—The local electric-light plant has been taken over by A. Welch, of Portland. The City Council has granted Mr. Welch a 25-year franchise.

CENTRAL POINT, ORE.—The California-Oregon Lt. & Pwr. Co. is planning to extend its transmission lines from Jacksonville into the Applegate Valley.

SPARTA, ORE.—Preparations are being made to rehabilitate the old Gem Mine, near Sparta. Electrically driven machinery will be used and pumping machinery purchased. E. and Frank Geiser are owners.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Nov. 14 for furnishing tubular boiler, switch stands, steel, iron and wire rope, chain, steel and iron pipe, etc. Copies of this circular (No. 741) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

BETHLEHEM, PA.—Notice has been filed that application will be filed for a charter for the East Bethlehem Township El. Co. for the purpose of generating electricity for lamps, heat and motors in this township. The incorporators are: W. B. Crawford, L. B. Custer and A. J. Armstrong.

CHESTER, PA.—The Edgmont Avenue Business Men's Association is agitating the question of providing a better lighting system on Edgmont Avenue.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Co. has authorized the purchase of 150 near-side surface cars and 50 cars for the Market Street subway-elevated service, delivery to begin May, 1913.

PHILADELPHIA, PA.—Specifications covering the arc-lamp system of the city streets for the next year with request for proposals have been issued by Chief Pike of the Electrical Bureau. Proposals for a more modern type of arc lamp are desired and also for tungsten incandescent lamps. It is proposed to recommend the use of incandensent lamps in the residential districts.

POTTSVILLE, PA.—The Philadelphia & Reading Coal & Iron Co., it is reported, contemplates the construction of a power dam in the Tumbling Run Valley, near Pottsville, plans for which have been prepared.

CANTON, S. D.—The local electric-light plant has been taken over by the Sioux Valley Pwr. Co., which will remodel same. The company will construct a dam next spring to furnish power for the plant.

CASTLEWOOD, S. D.—The contract for the construction of power house for the electric light company has been awarded to the Lytle Constr. Co., of Sioux Falls, Ia.

PARKER, S. D.—Charles H. Stanfield has applied to the Council for a franchise to install and operate an electric-light plant here.

CHATTANOOGA, TENN.—Plans have been prepared for the installation of an ornamental street-lighting system in Chattanooga. Specifications provide for 114 inverted lamps, maintained by underground wires. The Retail Merchants' Association of the Lookout City will have charge of the work.

CHUCKEY, TENN.—Plans are being considered for the construction of a second hydroelectric plant on the Nolachuckey River, in Greene County, options have been taken on all the land needed for the plant, also for the land to be overflowed. Victor M. Weaver, James L. Stewart, Noah T. Halsey and Samuel K. Varner, all of Harrisburg, Pa., and J. F. Arnold, of Limestone, Tenn., are interested.

GAINESVILLE, TENN.—The Republic Surety, Fidelity & Trust Co., of Dallas, is reported to have taken over the proposition for the construction of an interurban electric railway between Gainesville and Sherman. This railway was started several years ago and partly built, 13 miles having been graded out of Gainesville. The new owners, it is stated, will push the road to early completion. C. L. Wakefield, of Dallas, will have charge of the project.

ABILENE, TEX.—The gas, electric and water systems and ice plant owned and operated by the Abilene Lt. & Wtr. Co., the Abilene Gas Lt., Fuel & Pwr. Co. and the Abilene Ice Co. have been acquired by N. W. Halsey & Co., New York, N. Y., for $600,000. Improvements involving an expenditure of about $100,000 are contemplated by the new owners.

CORPUS CHRISTI, TEX.—The Corpus Christi Ice & El. Co. is planning to double the output of its electric light and power plant and will also install additional machinery in its ice plant.

EAGLE PASS, TEX.—The electric plant of the Texas-Mexican El. Lt. & Pwr. Co. here has been purchased by J. F. Strickland, of Dallas, and associates. The new owners propose to build an electric railway system in Eagle Pass and Piedras Negras, situated in Mexico, just across the Rio Grande from Eagle Pass, and to extend the electric-lighting system to both cities.

GEORGETOWN, TEX.—The Citizens' El. Lt. & Pwr. Co. has been granted a franchise to erect a transmission line from Taylor to Circleville on San Gabriel River, a distance of 6 miles.

HALLETTSVILLE, TEX.—The City Council has authorized the city secretary to secure estimates on the cost of a dynamo of sufficient output to maintain 2500 or 3000 lamps.

HOUSTON, TEX.—The Houston El. Co. has increased its capital stock from $3,000,000 to $4,000,000, the proceeds to be used for additional improvements.

HOUSTON, TEX.—The City Council has granted L. A. & C. L. Anderson a franchise to erect and operate a transmission line from the city limits to a point beyond Bray's Bayou on the Main Street road.

LOCKHART, TEX.—The County Commissioners and the City Council have granted W. B. Dunlap, of Beaumont; J. W. Crawford and F. W. Brown, of Orange; J. M. Abbott, of Seguin, and J. W. Maxey, of Houston, representing the promoters of an interurban railway from Houston to Lockhart, Seguin, New Braunfels and San Antonio, a franchise through Caldwell County and Lockhart. Work will begin at once on construction of the road. Power for operating the proposed railway will be supplied by two hydroelectric plants to be erected on the Guadalupe River between Seguin and New Braunfels, at a cost of about $600,000.

WACO, TEX.—The Texas Lt. & Pwr. Co. has purchased a site of 10 acres in Waco, on which it will erect a central power plant to cost about $600,000. This plant will supply electricity for operating the interurban railway of the Southern Trac. Co.

CLIFTON FORGE, VA.—The Clifton Forge Pub. Ser. Corpn. has changed its name to the Virginia-Western El. Co. The company has recently acquired the property of the Rockbridge Pwr. Corpn. and the Buena Vista Lt. & Pwr. Co., both of Buena Vista, consisting of two hydroelectric plants on North River and supplying electricity for lamps and motors in Lexington and Buena Vista. Surveys have been completed and details planned for proposed hydroelectric development. Work on the proposed project will not begin before next spring. W. G. Matthews is president and A. C. Ford secretary and treasurer, both of Clifton Forge.

RICHMOND, VA.—The electric committee has voted to recommend to the Council better illumination for the parks and streets; also that it supply all electricity needed at the Mechanics' Institute, which will be used in the manual training department. It is proposed to place boulevard lamps in all the parks and in Eighth Street from Broad to Byrd Street.

POTLATCH, WASH.—The West Coast Pwr. Co. is planning to build a 300-hp hydroelectric plant here. J. E. Wickstrom, Epler Block, Seattle, Wash., is engineer.

SEATTLE, WASH.—The proposition to install a municipal telephone system here will soon be submitted to the voters. Plans for the proposed telephone system will be prepared by A. L. Valentine, superintendent of public utilities.

SEATTLE, WASH.—Plans are being considered by E. M. Mills and prominent residents of Ranier Valley, near Seattle, for the construction of an electric railway, 6 miles long, which will connect with the Seattle, Renton & Southern Railway.

TACOMA, WASH.—Arvid Rydstrom, engaged by the city to make investigations in connection with the municipal hydroelectric plant on the Nisqually River, has submitted his report to the Council. Mr. Rydstrom advocates the construction of an auxiliary power plant on the Green River water-system pipe line at McMillin, where waste water can be utilized to develop 1000 hp or more. The cost of the plant is estimated at $75,000. It is also suggested as another solution that the city build a steam plant in the city having an output of about 5000 hp. This plant would furnish steam for heating purposes to be sold in the downtown district. The cost of the steam plant is estimated at between $200,000 and $250,000.

VANCOUVER, WASH.—The proposition to issue $10,000 in bonds for the installation of a fire-alarm system will be submitted to the voters on Nov. 5.

WENATCHEE, WASH.—An election will soon be held to vote on the proposition to issue $6,000 in bonds for the installation of a cluster-lamp lighting system, $4,500 for installing a fire-alarm system and $5,000 for automobile fire apparatus.

CHARLESTON, W. VA.—The Virginia Pwr. Co., which was recently organized to acquire lands, water rights, etc., owned or controlled by the West Virginia Pwr. Co., Dominion Pwr. Co. of West Virginia, and Dominion Pwr. Co. of Virginia, and for acquisition of other public utilities in West Virginia, has commenced work on constructon of a 15,000-kw auxiliary steam power station on Great Kanawha River at Cabin Creek, 12 miles from Charleston. The plans provide for the erection of about 200 miles of transmission lines penetrating Kanawha and New River district coal fields. The company also owns four water-power sites on New River as follows: Bull Shoal, where it is estimated that 100,000 kw can be developed; Bluestone, 125,000 kw; Richmond Falls, 15,000 kw., and Gauley Junction, 30,000 kw. Work has commenced on construction of dam at Bull Shoal, 125 ft. high, with crest length of about 1400 ft. Charles O. Lenz, 71 Broadway, New York, is chief engineer.

WARWOOD, W. VA.—The Town Council has granted the Brooke El. Co. a franchise to supply electricity here. The company, it is said, is owned by interests connected with the Pan-Handle Trac. Co., Wheeling, W. Va. G. O. Nagle and E. Wright, of Wheeling, are interested.

DELAVAN, WIS.—The United Ht., Lt. & Pwr. Co., Delavan, is contemplating extending its transmission lines to Clinton and expects to be ready to furnish electrical service by Jan. 1, 1913.

EAU CLAIRE, WIS.—The Chippewa County Tel. Co. is planning to install a complete automatic system in both Eau Claire and Chippewa Falls. The capital stock of the company has been increased to $150,000.

LA CROSSE, WIS.—Sealed proposals will be received by the Board

of Public Works of the city of La Crosse until Nov. 22 for furnishing and installing materials and appliances in connection with certain additions to the city water-works system as follows: No. 3 (f)—furnishing and erecting upon its foundation one 8,000,000-gal. cross-compound pumping engine; (g)—furnishing and erecting two 125-kva turbo-generators and condensers; (h)—furnishing and erecting in the substations five centrifugal pumps and motors, vertical-shaft type; (i)—furnishing material and erecting about 5100 ft. of electric transmission line, also switchboard and all electrical connections; (j)—furnishing one open feed-water heater; (k)—furnishing and erecting one 15-ton traveling crane; (o)—furnishing material and equipping three internally fired boilers with furnaces and miscellaneous attachments. Plans and specifications may be examined at the office of the Board of Public Works, La Crosse; office of Alvord & Burdick, engineers, 1417 Hartford Building, Chicago, Ill., and Builders' Exchange, St. Paul, Minn. Copies of specifications may be obtained from the Board of Public Works upon deposit of $5 per set, which will be refunded upon return of same.

NELSON, B. C., CAN.—The federal government is planning to construct a telephone line between Nelson and Waneta, a distance of about 35 miles.

VANCOUVER, B. C., CAN.—The British Columbia Tel. Co. is planning extensive improvements to its system in British Columbia, involving an expenditure of about $1,000,000. The proposed work includes the erection of a building for a plant, a six-story combination and warehouse building, two or three exchange buildings in Vancouver and two in Victoria. George H. Halse is secretary of the company.

VANCOUVER, B. C., CAN.—The Fort George Pwr. Co. has filed application for permission to store 121,600 acre ft. of water from Willow Creek in reservoirs to be constructed at Stony Lake, Round Lake, Stephens Lake and connecting waterways; 92,000 acre ft. of water to be stored in reservoirs to be built at Petonie; 89,600 acre ft. at St. Mary's Lake, Fraces Lake, St. Joseph Lake and connecting waterways; also for storing 14,400 acre. ft. of water at Jack of Clubs' Lake and 52,000 acre ft. at Narrow Lake. The water will be used for power purposes.

HANLEY, MAN., CAN.—The ratepayers have voted in favor of the by-law authorizing the Council to make an appropriation for the construction and equipment of an electric-light plant. A Holm is clerk.

WINNIPEG, MAN., CAN.—The City Council contemplates erecting ornamental street lamps on Donald and Edmonton Streets, to cost about $6,000. C. J. Brown is clerk.

WINNIPEG, MAN., CAN.—The Canadian Domestic Engineering Co. has been engaged as consulting engineer in connection with the installation of heating, plumbing, ventilating, electric works and central power plant and equipment of the new parliament buildings, Wininpeg. The cost of the buildings is estimated at about $5,000,000 and the engineering work at $800,000.

GLENCOE, ONT., CAN.—The Council contemplates extensive repairs to the municipal electric-light plant. Considerable new equipment will be required. George Wilson is clerk.

INGERSOLL, ONT., CAN.—Extensions are contemplated to the municipal street-lighting system. It is proposed to install a large number of lamps. For further information address Mayor Coleridge.

ROSETOWN, SASK., CAN.—Plans are being considered for the installation of an electric-light system here. S. B. Robinson is secretary and treasurer.

WADENA, SASK., CAN.—The contract for the installation of a municipal electric-light plant here has been awarded to Mr. Cable, of the British-American Engineering Co., of Winnipeg. A by-law appropriating $20,000 for the installation of the proposed plant was recently passed.

New Industrial Companies

THE AIR ELECTRIC ENGINE & DEVELOPMENT COMPANY has filed articles of incorporation with a capital stock of $100,000 under the laws of the State of Delaware. The incorporators are: G. T. Thompson, F. J. Seydel and A. L. Spence, of Philadelphia, Pa.

THE W. W. CLARKE COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $10,000 by William W. Clarke, Marion M. Clarke and William A. Flanigan, all of 26 Court Street, Brooklyn. The company proposes to deal in vacuum cleaning machines, etc.

THE DUNLAP-DIPPOID COMPANY, of Edwardsville, Ill., has been incorporated by Orie T. Dunlap, John Dippoid and Clara B. Dunlap. The company is capitalized at $20,000 and proposes to construct railways, power plants, etc.

THE ELECTRIC MOTOR CHAIR COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000 to manufacture and deal in motor-operated and manually-propelled wheel chairs, etc. The incorporators are: C. B. Chrysler, C. G. Traver and J. G. Bennett.

THE M. & O. AUTOMATIC SWITCH COMPANY, of Michigan City, Ind., has been incorporated with a capital stock of $30,000 to manufacture devices to control electricity, etc. The incorporators are: Walter H. Meller, Cornelius E. Orth and Fred M. Smith.

THE MERCHANT ENGINEERS' CORPORATION, of New York, N. Y., has been incorporated by J. Sattora, J. J. Phelan and E. D. Dietz, of New York. The company is capitalized at $25,000 and proposes to deal in engineering equipment.

THE ORSWELL ELECTRIC COMPANY, of Boston, Mass., has been incorporated with a capital stock of $50,000 by Israel C. Orswell, Annie E. Orswell and Joseph R. Fuller.

JAMES W. POOLE, INC., of Boston, Mass., has been incorporated by James W. Poole, Mary E. Poole, Benjamin F. Haines and William J. Miller. The company is capitalized at $50,000 and proposes to manufacture and deal in electrical supplies.

THE POWER DEVELOPMENT COMPANY, LTD., of New York, N. Y., has been incorporated with a capital stock of $25,000 to do a general contracting and engineering business. The incorporators are: D. O. Elder, C. A. Freud and Harrison H. Boyce, of New York, N. Y.

THE ROBERTSON ELECTRIC COMPANY, of Owensboro, Ky., has been organized by G. U. Robertson to deal in electrical supplies and to do a general electrical business. P. F. E. Lee is superintendent.

THE STANDARD AUTOMATIC MANUFACTURING COMPANY, of Augusta, Maine, has been incorporated with a capital stock of $2,500,000 to manufacture and deal in sound-recording and sound-producing machines. E. M. Leavitt, of Augusta, Maine, is president and treasurer.

THE TRI-UNIT ELECTRICAL COMPANY, of Newark, N. J., has been incorporated with a capital stock of $100,000 to do a general automobile business. The incorporators are: J. B. Stobaeus, Jr., B. W. Matthews and W. C. Stobaeus, of Newark, N. J.

THE VIGLIANO SIGNAL CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture patented articles, specialties, etc. The incorporators are: L. Culler, J. Vigliano and J. Reiss, of New York, N. Y.

THE WESTERN ELECTRIC TESTING COMPANY, of Indianapolis, Ind., has been incorporated by Charles Weiland, Albert A.. Bowvy and Frank Starky. The company is capitalized at $25,000 and proposes to manufacture and sell magneto and electrical ignition apparatus testers; also electrical appliances, apparatus and supplies, etc.

New Incorporations

CHICAGO, ILL.—The Central Oregon Pwr. Co. has been incorporated with a capital stock of $100,000 to supply power, water, light and heat. The incorporators are: Harvey L. Hamsen, Albert C. Ball and Arthur H. Boettcher.

LIBERTY, N. Y.—The Liberty & Calicoon R. R. Corpn. has been incorporated with a capital stock of $200,000 to operate an electric or steam railway in Sullivan County from Liberty through White Sulphur Springs and Youngsville to Jeffersonville, a distance of 14 miles. The directors include: Lowell H. Brown, Archer Brown, of New York; Stanley F. Crocker, of Brooklyn; Charles B. Ward and Frank E. Bridges, of Liberty.

SCHODACK LANDING, N. Y.—The Schodack Lt. & Pwr. Corpn. of Rensselaer County has been incorporated with a capital stock of $10,000 by O. D. Woodford, Charles Van Buren and William I. Gardenier, of Schodack Landing. The company proposes to supply electricity in Rensselaer County.

KINGSVILLE, OHIO.—The Conneaut, Kingsville & Ashtabula Ry. Co. has been incorporated by William E. Hawley, Raymond C. Thompson and Charles E. Hawkins. The company is capitalized at $25,000 to build an electric railway between Conneaut and Ashtabula and to furnish electricity for lamps and motors in both towns.

TOLEDO, OHIO.—The Valley Lt. & Pwr. Co. has been chartered with a capital stock of $200,000 to supply electricity for lamps, heat and motors. The incorporators are: E. Rheinfrank, W. P. Wallace, A. M. Hoover, F. W. Crabbs and F. M. Mark.

HARRISBURG, PA.—Charters have been granted by the Secretary of State as follows: Beaver County Pwr. Co., of Beaver Falls, with a capital stock of $5,000; Clairton & Blair Street Ry. Co., of Clairton, with a capital stock of $6,000; Beaverdale El. Lt., Ht. & Pwr. Co., of Stoystown, with a capital stock of $10,000.

JOHNSTOWN, PA.—Charters have been granted to the Ryder, St. Clair and Fairfield Lt., Ht. & Pwr. Cos. to operate in townships of Westmoreland County. Each company is capitalized at $5,000.

CHARLESTON, S. C.—The Charleston & Summerville Interurban Ry. Co. has been chartered with a capital stock of $500,000 to build an electric railway between Charleston and Summerville, a distance of 20 miles, and several miles of track in Charleston. The officers are: J. L. David, president; E. W. Hughes, secretary, and M. M. David, treasurer.

GREENVILLE, S. C.—The Cedar Falls Lt. & Pwr. Co. has been granted a charter with a capital stock of $50,000 to carry on a general light and power business. The officers are: B. E. Greer, president and treasurer; D. D. Davenport, vice-president, and J. M. Greer, secretary.

SELMER, TENN.—The Selmer El. Lt. & Gin Co. has been organized with a capital stock of $5,000 and the following named officers: C. B. Steadman, president; F. F. Hendrix, vice-president; Albert Gillespie, secretary and treasurer, all of Bethel Springs; W. M. Brown, of Selmer, general manager, and D. G. Robinson, manager of light plant.

CONROE, TEX.—The Conroe Gin, Lt. & Ice Co. has been organized with a capital stock of $20,000 by J. Wahrenberger, C. P. McDade, Mrs. M. E. Uzzell and others.

OGDEN, UTAH.—The El. Service Co. has been incorporated with a capital stock of $10,000. The officers are: George W. Barlow, president and treasurer; Charles Hartley, vice-president, and Joseph W. Barlow, secretary.

LAHORE, VA.—The Pamunkey Mutual Tel. Co. has been chartered with a capital stock of $5,000. The officers are: W. N. Green, of Lahore, president; M. S. Johnson, Monrovia, secretary, treasurer and general manager.

SEATTLE, WASH.—The Northwest El. & Wtr. Co. has been incorporated with a capital stock of $500,000 by Clark M. Burkheimer and John E. Burkheimer.

BARABOO, WIS.—The Midwestern El. Mfg. Co. has been incorporated with a capital stock of $25,000 by Michael Debrey, R. A. Schurr and C. F. Kinschi.

MADISON, WIS.—The Wisconsin Gas & El. Co. has been incorporated with a capital stock of $1,200,000 for the purpose of becoming a holding company for the public utility properties in this State. The company, it is understood, will take over the public utilities in Kenosha and Racine, including the plants of the Kenosha Gas & El. Co., the Kenosha El. Ry. Co. and the Racine Gas Lt. Co.

Trade Publications

BRIDGES.—"Steel Transmission Structures and Catenary Bridges" is the title of a brochure issued recently by the Archbold-Brady Company, Syracuse, N. Y., engineer and contractor. Brief descriptions with illustrations of typical installations are given. The illustrations were selected from a large number of structures designed, fabricated or erected by the Archbold-Brady Company, and represent the successful solution of a variety of problems. The constantly increasing use of steel structures for supporting and anchoring electric transmission lines and overhead systems of electric railways makes this booklet of timely interest.

WIRING SPECIALTIES.—In Catalog No. 20, recently brought out by Pass & Seymour, Inc., Solvay, N. Y., "Passmour," "Fluto" and "Shurlock" wiring devices are listed in detail and to each specialty is given a brief illustrated description. The new catalog contains information with respect to various new appliances not previously catalogued, and will therefore be of fresh interest to dealers, contractors and others having use for cleats, insulators, receptacles, sockets and other wiring devices. It contains eighty pages, inclusive of complete numerical and alphabetical indexes, and is strongly bound with red pasteboard covers.

CARELS-DIESEL ENGINES.—The foreign firm of Carels Brothers, whose large works at Ghent, Belgium, are now being devoted exclusively to the manufacture of Diesel engines, has distributed an attractive illustrated catalog describing the construction and general features of these prime movers. Illustrations are given showing Diesel installations for the Midland Railway Company, England; the Calcutta Tramways Company, Ltd., India; the power plant of the Daimler Motor Company, Ltd., Coventry, England; the Caracas Tramways, Venezuela, and the power plant of Messrs. Sassoon & Company, cotton manufacturers, of Bombay, India.

VACUUM CLEANING.—Volume II on "Vacuum Cleaning," a copyrighted publication of the United Electric Company, Canton, Ohio, has recently been issued. The rapid growth and development of the vacuum-cleaning industry has created a demand for definite information on which architects and engineers might base their calculations, which this little volume is designed to meet. Tables on velocity and vacuum loss based on standard sizes of wrought iron or steel pipe are given, and also other tables frequently needed in designing vacuum cleaning installations. The booklet will be found of special value to engineers and architects.

WATER STRAINERS.—Lagonda multiple water strainers are the subject of a recent bulletin—R-1—which has been issued by the Lagonda Manufacturing Company, Springfield, Ohio. The necessity for a strainer and the loss of power in plants due to decreasing the vacuum by restricting the flow of condenser circulation water are considered, and the various sizes and types of strainers are illustrated and briefly described. Two photographs are given, one before and one after the strainers have been put in, showing that available floor space is not decreased, as these strainers may be buried under the floors with only the hand-wheel projecting above the surface.

ENGINEERING AND CONSTRUCTION.—The H. A. Strauss Company, Stock Exchange Building, Chicago, successor to the Falkenau Electrical Construction Company, has issued a booklet telling what work it is prepared to do and illustrating and describing, briefly, some of its undertakings, including electrical work for the United States Steel Corporation at Gary, Ind.; Pittsburgh Plate Glass Company, Crystal City, Mo.; International Harvester Company, Chicago; Merchants' Light & Power Company, Ogden, Utah; United States Crushed Stone Company, near Chicago, and Davis & Weber Counties Canal Company, Utah. Mr. H. A. Strauss is president and chief engineer of the company.

THE ELECTRIC TRUCK.—The General Motors Truck Company, Detroit, Mich., has recently issued a forty-eight-page booklet on its "GMC" electric trucks. The text contains short chapters devoted to the field of the electric truck, a few facts not generally known, the development of the electric truck, and other information of interest and value to the up-to-date men whose business calls for much truck service and to the power salesmen of the electric light companies. The booklet tells a great deal about the construction of these trucks, and the central double-page is devoted to an illustration showing the operating advantages which are exclusive with the "GMC" electric trucks, the whole making a practical little manual.

LIFTING MAGNETS.—The September, 1912, bulletin of the Cutler-Hammer Clutch Company, Milwaukee, Wis., No. 12,000, is devoted to its direct-current circular-type lifting magnets. Since the introduction of magnets the cost of handling iron and steel has been greatly reduced. The catalog gives considerable practical, illustrated information on the lifting capacity of these magnets, their construction, method of control and use on direct-current circuits, besides a numerical list of eighteen structural features indicated in the diagram of a Cutler-Hammer magnet. It shows the use of this class of apparatus for a great variety of purposes. The log sheet of the dock superintendent of the Inland Steel Company, showing the record made by two Cutler-Hammer 62-in. magnets unloading 4,000,000 lb. of pig-iron in ten and a half hours from the steamer *Erwin L. Fisher*, is reproduced in this bulletin.

DETECTOR.—The "KK" detector, manufactured by the International Railophones, Ltd., Prudential Buildings, Corporation Street, Birmingham, England, is the subject of Bulletin No. 3, recently issued by this company. In the preface Mr. H. Von Kramer, managing director of the Railophones, says that in his research work he found it desirable to obtain some form of "calling-up" relay in order to obviate the necessity of constant attendance on the part of the operator. It was necessary that the instrument should be able to respond to currents of the order of 0.0002 amp, flowing under an emf of about 0.02 volt at a frequency of 100 cycles per second; also that it should not be affected by mechanical shocks. In collaboration with Dr. Gisbert Kapp, Mr. Kramer succeeded in constructing a delicate alternating-current relay which may be employed not only for "calling up," but for any other purpose for which the ordinary telegraphic relays requiring far heavier currents are usually employed. The bulletin contains an illustrated description of this relay and a diagram of connections.

Business Notes

THE CORTLANDT ENGINEERING COMPANY moved on Oct. 26 from 39 Cortlandt Street to 146 Liberty Street, New York City, where it will continue to carry on a general electrical contracting and engineering business. The president of the company is Mr. L. F. Duke.

THE CRYPTO ELECTRICAL COMPANY, London, has purchased a tract of land at Acton Lane, Willesden, on the outskirts of London, on which it has erected a new factory, which will be an auxiliary to its factory in Bermondsey Street. The latter will continue as heretofore without any alteration.

EVANS, ALMIRALL & COMPANY, contracting engineers, Dominick & Clarke Streets, New York, announce that Mr. P. A. Hoffman has become associated with their company in the engineering sales department. Mr. Hoffman was formerly sales manager of the New York branch of the B. F. Sturtevant Company.

THE WHEELER CONDENSER & ENGINEERING COMPANY, Carteret, N. J., manufacturer of high-vacuum surface and jet condensers and general condensing machinery, has opened an office in Cleveland, Ohio, at 1325 Citizens' Building, which will be under the management of Mr. Walter G. Stephan.

MR. JOSEPH T. FEWKES has severed his connection with the Fewkes-Whalen Company and is now located at 124 North Twelfth Street, Philadelphia, under the firm name of Joseph T. Fewkes & Company, electrical and steam engineers. The company deals in new and second-hand machinery and also does repairing.

WERN MACHINERY & ENGINEERING COMPANY.—The "Synchrone" artificial respiration apparatus, which was described in our issue of Dec. 23, 1911, is now manufactured in this country by the Wern Machinery & Engineering Company, 30 Church Street, New York. The device was awarded a "diploma of honor" at the ninth International Red Cross Conference, recently held at Washington, D. C.

STUART-HOWLAND COMPANY, Boston, Mass., distributor of electrical supplies and apparatus, has enlarged its sales force by the addition of Messrs. W. C. Drouet and George H. Boucher. Mr. Drouet was formerly a member of the firm of Ward, Drouet & Foster, electrical jobbers, Boston, and Mr. Boucher was formerly with the Royal Eastern Electric Supply Company, Albany, N. Y. The latter will hereafter represent the Stuart-Howland Company in the district between Poughkeepsie and Glens Falls, N. Y.

THE LACLEDE-CHRISTY CLAY PRODUCTS COMPANY, of St. Louis, Mo., has appointed Mr. T. E. Gannett representative in charge of its Chicago office, 1366 People's Gas Building. Mr. Gannett succeeds Mr. F. L. Bunton, resigned. He will take care of all matters pertaining to the chain-grate stoker department of the Laclede-Christy company in the Chicago territory, in addition to which he will attend to all business relating to general sales in the glass industry and gas-engineering departments.

Directory of Electrical Associations, Societies, Etc.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary-treasurer, Geo. E. Emery, 11 N. Royal St., Mobile, Ala. Annual convention, Birmingham, November 14 and 15, 1912.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary-treasurer, Matthew R. Boylan, Public Service Railway Co., Newark, N. J.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, 29 West 39th St., New York.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, H. C. Donecker, 29 West 39th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 E. 11th St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary-treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 29 West 39th St., New York. Meeting, second Friday of each month, October-May.

AMERICAN PHYSICAL SOCIETY. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y. Annual meeting, Cleveland, Ohio, jointly with the American Association for the Advancement of Science, December, 1912.

AMERICAN WATER WORKS ASSOCIATION. Secretary, J. M. Diven, 271 River St., Troy, N. Y.

ARKANSAS ASSOCIATION PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, James Farrington, Steubenville, Ohio.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Jos. A. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 112 West Adams St., Chicago. Annual meeting, St. Louis, Mo., May 20, 1913.

COLORADO ELECTRIC CLUB. Secretary, C. F. Oehlmann. Meets every Thursday at Albany Hotel, Denver, Col.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, Thomas F. Kennedy, 900 15th St., Denver, Col.

ELECTRIC CLUB OF CHICAGO. Secretary, W. M. Connelly, 1417 Monadnock Block, Chicago. Meets every Thursday noon at Hotel Sherman.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Annual meeting, Syracuse, N. Y., Jan. 21, 1913.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1613 Grand Ave., Kansas City, Mo.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, Albert Petermann, Milwaukee, Wis.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL CREDIT ASSOCIATION OF PHILADELPHIA. Secretary-treasurer, John W. Crum, 1324 Land Title Building, Philadelphia, Pa. Executive Committee meets second and fourth Thursday of each month.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January each year.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. Secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill. Next quarterly meeting, Hot Springs, Va., November 13-15, 1912.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Harding Building, 34 Ellis St., San Francisco, Cal. Meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d Street, New York. Meeting, fourth Tuesday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA, NEW ENGLAND SECTION. Secretary, W. E. Holmes, 46 Blackstone St., Boston, Mass. Meetings monthly upon notice.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla.

GAS, ELECTRIC & STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, Prof. H. V. Bozell, Norman, Okla.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. General Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia, Chicago and Pittsburgh.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, A. Newburger, 1153 Myrtle Ave., Brooklyn, N. Y. Meetings second and fourth Wednesdays, New Grand Hotel, New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, 120 So. Meridian St., Indianapolis, Ind. Annual meeting, Indianapolis.

INSTITUTE OF RADIO ENGINEERS. Secretary, E. J. Simon, 81 New St., New York. Meeting, first Monday of each month.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS. Secretary, H. J. F. Porter, 29 West 39th St., New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL COMBUSTION ENGINEERS' ASSOCIATION. President, Charles Kratsch, 416 W. Indiana St., Chicago. Meeting, second Friday of each month at Lewis Institute.

INTERNATIONAL ELECTRICAL CONGRESS. Secretary, J. A. Barus, Exposition Bldg., San Francisco, Cal. San Francisco, 1915.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Next meeting at Berlin in 1913.

IOWA ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Annual convention, Waterloo, April 23-24, 1913. Secretary, A. W. Zahm, Mason City, Ia.

IOWA STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Annual meeting, April, 1913, Waterloo, Ia.

JOVIAN ORDER. Jupiter (president), F. E. Watts, Western Electric Co., New York; Mercury (secretary), E. C. Bennett, St. Louis, Mo.

KANSAS GAS, WATER, ELECTRIC LIGHT & STREET RAILWAY ASSOCIATION. Secretary-treasurer, W. H. Fellows, Leavenworth, Kan.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, W. H. Bower Spangenberg, 625 Poydras St., New Orleans, La. Meets second Thursday of each month.

MAINE ELECTRIC ASSOCIATION. Secretary, Walter S. Wyman, Waterville, Maine.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary E. F. Strong, Chaska, Minn. Sixth annual convention, March 15-22, 1913.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER WORKS ASSOCIATION. Secretary-treasurer, P. W. Markham, Brookfield, Mo. Next convention at Mexico, Mo., 1913.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, Wm. L. Smith, Concord, Mass.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual meeting, Chicago, May, 1913.

NATIONAL ELECTRIC LIGHT ASSOCIATION, CANADIAN SECTION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

NATIONAL ELECTRIC LIGHT ASSOCIATION, COMMERCIAL SECTION. Secretary, E. L. Callahan, 29 West 39th St., New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION, EASTERN NEW YORK SECTION. Secretary, R. H. Carlton, General Electric Company, Schenectady, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-treasurer, M. H. Hendle, Augusta, Ga.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MICHIGAN SECTION. Secretary Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MISSISSIPPI SECTION. Secretary, A. H. Jones, McComb City, Miss.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NORTHWEST SECTION. Secretary, N. W. Brockett, Pioneer Building, Seattle, Wash.

NATIONAL ELECTRIC LIGHT ASSOCIATION, HYDROELECTRIC AND POWER TRANSMISSION SECTION. Secretary, Farley Osgood, Public Service Electric Company, Newark, N. J.

National Electric Credit Association. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

National Fire Projection Association. Secretary-treasurer, Franklin H. Wentworth, 87 Milk St., Boston, Mass. Next annual meeting, New York, May 13-15, 1913.

National Independent Telephone Association. Secretary-treasurer, Richard Valentine, Janesville, Wis.

New England Electrical Credit Association. Secretary, Alton F. Tupper, 60 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Electric Development Association. Secretary, Zenas W. Carter, 53 State St., Boston, Mass.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New Orleans Electrical Contractors' Association. Secretary, S. J. Stewart, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

New York Electrical Credit Association (affiliated with the National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

New York Electric Railway Association. Secretary, Charles C. Dietz, United Traction Company, Albany, N. Y.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Annual meeting, Akron, Ohio, Nov. 21 and 22, 1912.

Pennsylvania Electric Association (State Section N. E. L. A.). Secretary-treasurer, Walter E. Long, 1000 Chestnut St., Philadelphia, Pa.

Pittsburgh Electrical Booster Club. Recording Watt, George H. Criss, 1806 Union Bank Building, Pittsburgh, Pa. Meeting, first Monday each month.

Railway Signal Association. Secretary, C. E. Rosenberg, Bethlehem, Pa.

Society for Electrical Development, Inc. Secretary, Philip S. Dodd, 29 West 39th Street, New York.

Society for the Promotion of Engineering Education. Secretary, Prof. H. H. Norris, Cornell University, Ithaca, N. Y.

Southwestern Electrical & Gas Association. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Texas.

Vermont Electrical Association. Secretary-treasurer, A. B. Marsden, Manchester, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill. Convention, St. Louis, Mo., Jan. 28-30, 1913.

Western Society of Engineers. Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meeting, fourth Monday of each month, except January, July and August. Annual meeting, Tuesday after Jan. 1 each year.

Wisconsin Electrical Association. Secretary, George Allison, Stephenson Building, Milwaukee, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 22, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,041,718. TELEGRAPHIC RELAY; H. J. Archer, Chicago, Ill. App. filed Feb. 8, 1912. Direct-reading signal.

1,041,720. AUTOMATIC FLATIRON; H. P. Ball, Pittsfield, Mass. App. filed Sept. 27, 1909. Automatic handle switch.

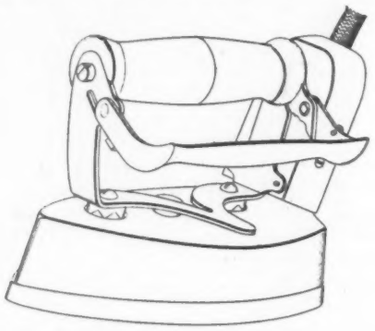
1,041,728. MEANS FOR PREVENTING THEFT OF CURRENT FROM ELECTRIC METERS; C. F. Bertig, Winsted, Conn. App. filed March 11, 1912. Circuit wire is anchored to the casing.

1,041,752. ARC-LIGHT ELECTRODE; John T. H. Dempster, Schenectady, N. Y. App. filed March 26, 1903. Method of making electrodes for luminous arcs.

1,041,771. ELECTRIC CLOCK; H. T. Gay, Baltimore, Md. App. filed March 14, 1912. Electrical magnetic escapement.

1,041,778. WELDING APPARATUS; J. H. Gravell, Philadelphia, Pa. App. filed Oct. 31, 1911. For welding large sheets, etc.

1,041,782. ELECTRIC MOTOR OR GENERATOR; E. A. Halbleib, Rochester, N. Y. App. filed Dec. 16, 1910. Commutator and brushes.



1,041,720.—Automatic Flatiron.

1,041,790. PROCESS FOR ELECTROLYTIC CLEANSING; A. Herrmann, Leipzig, Germany. App. filed April 8, 1912. For preparing metal for plating.

1,041,817. METALLIC-FILAMENT LAMP; O. Krause, Berlin, Germany. App. filed Oct. 16, 1909. Elastic carrier support.

1,041,845. MOTOR-CONTROL SYSTEM; E. J. Murphy and J. Eaton, Schenectady, N. Y. App. filed May 4, 1912. Reversible motor, for planers, printing presses, etc.

1,041,846. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed May 20, 1912. Plug and fuse strip.

1,041,847. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed May 31, 1912. Gang fuse plug.

1,041,859. MOTOR-CONTROLLING DEVICE; T. W. Nowell, Schenectady, N. Y. App. filed May 19, 1911. Split-phase starting; unidirectional movement.

1,041,868. ALTERNATING-CURRENT-MOTOR CONTROL; W. B. Potter, Schenectady, N. Y. App. filed April 2, 1910. Compensated series-type automatic circuit changing.

1,041,873. ELECTRIC-LAMP SOCKET; W. A. Richardson, Chicago, Ill. App. filed May 16, 1912. Bridging circuit for detecting defective lamps.

1,041,888. OUTLET-BOX BUSHING; P. C. Schorr, St. Paul, Minn. App. filed Sept. 27, 1911. Removable conduit closure.

1,041,929. TROLLEY-SWITCH MECHANISM; O. G. West, Gary, Ind. App. filed Jan. 26, 1911. Track and pole switch.

1,041,937. INSULATOR BRACKET; D. W. Wyche, Marquez, Tex. App. filed April 16, 1912. Multi-part insulator.

1,041,943. ELECTRIC BELL OR RINGER; C. R. Albertus, Chicago, Ill. App. filed Jan. 17, 1908. Adjustable telephone gong.

1,041,965. PARTY-LINE TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed March 27, 1907. Local magneto call.

1,041,966. CIRCUIT MAKE-AND-BREAK DEVICE FOR RAILWAY SIGNALING SYSTEMS; W. J. Cook, Denver, Col. App. filed Jan. 10, 1911. Car-operated switch.

1,041,982. CURRENT CONTROLLER; G. B. Dusinberre, Cleveland, Ohio. App. filed May 8, 1911. Compressible resistance medium.

1,042,019. INSULATING JOINT; L. McCarthy, Boston, Mass. App. filed Jan. 13, 1912. Connected insulated screw sockets.

1,042,028. RAILWAY SIGNALING DEVICE; J. W. Page, Quitman, Ark. App. filed April 1, 1912. Clear and danger signal operated by the engineer.

1,042,103. SWITCH-LOCKING MECHANISM; T. M. Freeble, Rochester, Pa. App. filed Oct. 12, 1910. Railway safety appliance.

1,042,111. METHOD FOR PRODUCING SO-CALLED POROUS METALS; H. I. Hannover, Copenhagen, Denmark. App. filed Dec. 2, 1911. An alloy is heated and one element driven out.

1,042,130. ELECTRIC CONTROLLING DEVICE; H. W. Leonard, Bronxville, N. Y. App. filed May 13, 1905. Rheostatic-controlling means provided with automatic protective devices.

1,042,153. TROLLEY CATCHER AND REPLACER; W. J. Scrimshaw, Chicago, Ill. App. filed Feb. 14, 1910. Movable lateral guards.

1,042,156. HEATER FOR STEERING DEVICES FOR MOTOR-DRIVEN VEHICLES; E. D. Shannon, Alpena, Mich. App. filed July 8, 1912. Electric lamp in the handle.

1,042,162. TROLLEY; F. Slonowski, Marianna, Pa. App. filed April 17, 1912. Self-adjusting.

1,042,179. PROCESS AND FURNACE FOR PRODUCING GAS REACTIONS; O. H. and K. Weber, Griesheim, Germany. App. filed June 7, 1912. The electrode charge is fed upwardly.

1,042,183. POLARIZING RELAY; J. L. Woodbridge, Philadelphia, Pa. App. filed March 21, 1910. Reducing the size of the polarizing coil when the current varies.

1,042,186. CIRCUIT-BREAKER; C. Ambruster, Chicago, Ill. App. filed Nov. 9, 1909. Adjustable setting

1,042,188. ADJUSTABLE TELEPHONE-INSTRUMENT-LOCKING DEVICE; C. H. Bard, Mount Vernon, N. Y. App. filed Oct. 28, 1911. A clamp for locking receiver hook.

1,042,199. WIRE CLAMP; H. L. Carroll, Gassaway, W. Va. App. filed April 6, 1912. For fastening a wire to a pole insulator.

1,042,228. PLUG SWITCH; C. Horn, Millbourne, Pa. App. filed Aug. 21, 1911. Insulated chambers and terminals.

1,042,244. ALARM; A. L. Macklin, Bryant, Ind. App. filed Jan. 26, 1911. For indicating temperature drop.

1,042,304. ELECTRICAL BONDING DEVICE; H. C. Williams, Utica, N. Y. App. filed Jan. 20, 1910. Rail-bond plate.

1,042,348. ELECTRIC ATTACHMENT PLUG; M. Herskovitz, Chicago, Ill. App. filed June 14, 1912. Separable body and sleeve.

1,042,372. SPLIT INSULATOR; J. R. Harris, Chartiers Township, Allegheny County, Pa. App. filed April 8, 1912. Cylindrical wiring knot.

1,042,375. ELECTRIC-ARC LAMP; W. Rühling, Berlin, Germany. App. filed Nov. 15, 1909. Heat-resisting non-conductor between parallel electrodes to extinguish arc automatically.